DOCUMENT RESUME

ED 423 128	SE 061 730

AUTHOR	Barracato, Jay; Spooner, Barbara
TITLE	Teach with Databases: Toxics Release Inventory. [Multimedia].
INSTITUTION	National Science Teachers Association, Arlington, VA.
PUB DATE	1998-00-00
NOTE	534p.; Accompanying CD-ROM not available from EDRS. "Getting Started" component previously entered into ERIC as ED 373 981.
AVAILABLE FROM	National Science Teachers Association, 1840 Wilson Blvd., Arlington, VA 22201-3000.
PUB TYPE	Guides - Classroom - Teacher (052)
EDRS PRICE	EDRS Price MF2 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	Biology; *Chemistry; Computer Uses in Education; Data Analysis; Data Collection; Elementary Secondary Education; General Science; Hands on Science; Physics; Pollution; *Relevance (Education); Science Activities; *Science Curriculum; *Scientific Methodology
IDENTIFIERS	Environmental Protection Agency; National Science Teachers Association

ABSTRACT

This curriculum unit provides students with real world applications of science as it pertains to toxic releases into the environment. This boxed package contains the Toxics Release Inventory (TRI) Teacher's Guide, TRI Database Basics guide, comprehensive TRI compact disk with user's guide, "Getting Started: A Guide to Bringing Environmental Education into your Classroom," and the Environmental Protection Agency's "Guide to Environmental Issues." Topics covered include identifying a local watershed and airshed, identifying toxic releases in a region, learning more about a toxic chemicals, conservation of mass, water quality monitoring, and bioaccumulation. With this kit, students learn how to collect and describe data, investigate data quality, identify trends in data, apply basic statistical methods to their data, and develop appropriate graphs. (DDR)

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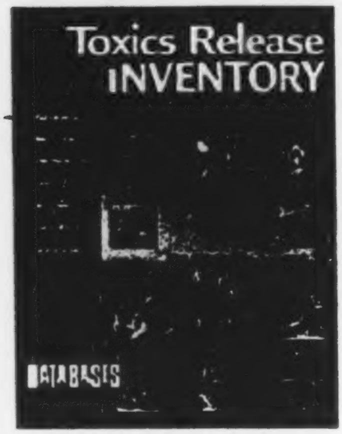
Teach With Databases: Toxics Release Inventory



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Key Features

- In addition to the *Toxics Release Inventory Teacher's Guide*, the Toxics Release Inventory Package includes Database Basics, the TRI CD-ROM (DOS) (accessible over the Internet for Macintosh or Windows Platform) and a comprehensive User's Guide, *Getting Started: A Guide to Bringing Environmental Education Into Your Classroom*, and EPA's *Guide to Environmental Issues.*
- Students can utilize both national data from TRI and local data they collect themselves to learn more about the environmental history of their community.
- In seven specific sections and additional readings, the TRI package contains activities and extensions that explore several aspects of chemicals (releases, transport, accumulation and breakdown, toxicity, and recycling) through hands-on and computer-based investigations.

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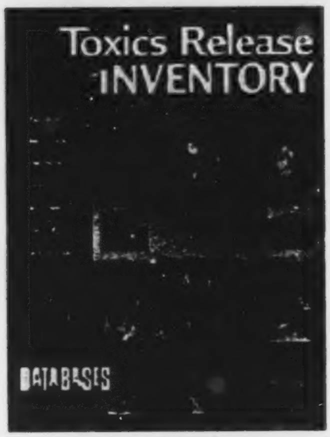
Teach With Databases:
Toxics Release Inventory



- General Information
- Key Features
- Frequently Asked Questions
- Related Publications from NSTA
- Ordering Information

General Information

Teach With Databases: Toxics Release Inventory
Grades 9-12, 1998.
#PB143X01, $35.00

In 1986, the U.S. Congress passed the Emergency Planning and Community Right to Know Act (EPCRA). Part of this legislation included the Toxics Release Inventory (TRI), a database managed and maintained by the U.S. Environmental Protection Agency (EPA). TRI includes over 600 chemicals that can be released into the air, water, and/or land. In accordance with EPCRA, private manufacturers and government facilities which have more than 10 employees, and manufacture or process over 11.312 kg of a TRI chemical, must meet TRI's reporting requirements.

Teach With Databases: Toxics Release Inventory was assembled by NSTA, with support from the EPA, in order to take advantage of the wealth of data that has been produced since EPCRA's implementation. The activities created by Jay Barracato, the author of the *Teacher's Guide*, focus on using TRI as a tool with which students and teachers can learn more about the chemical history of their community. The seven specific chapters offer hands-on and computer-based activities which incorporate the methods used by private and government facilities to monitor and test chemicals into the chemistry curriculum.

Ordering Information

Key Features

- In addition to the *Toxics Release Inventory Teacher's Guide,* the Toxics Release Inventory Package includes Database Basics, the TRI CD-ROM (DOS) (accessible over the Internet for Macintosh or Windows Platform) and a comprehensive User's Guide, *Getting Started: A Guide to Bringing Environmental Education Into Your Classroom*, and EPA's *Guide to Environmental Issues.*
- Students can utilize both national data from TRI and local data they collect themselves to learn more about the environmental history of their community.
- In seven specific sections and additional readings, the TRI package contains activities and extensions that explore several aspects of chemicals (releases, transport, accumulation and breakdown, toxicity, and recycling) through hands-on and computer-based investigations.

Ordering Information

Frequently Asked Questions

What is TRI?

TRI is the Toxics Release Inventory database, and is maintained by the U.S. Environmental Protection Agency. TRI is one of the main provisions of the Emergency Planning and Community Right-to-Know Act (EPCRA), which was passed by Congress in 1986, and includes over 600 chemicals that can be released into the air, water, and/or land. In accordance with EPCRA, private manufacturers and government facilities which have more than 10 employees and manufacture or process over 11.312 kg of the TRI chemicals must meet TRI's reporting requirements.

What is in the Toxics Release Inventory Package?

Teach With Databases: Toxics Release Inventory contains two NSTA publications and several U.S. EPA materials. The *Toxics Release Inventory Teacher's Guide* provides over 15 hands-on and computer-based activities which integrate the Toxics Release Inventory database (TRI) with chemistry laboratory investigations. Database Basics is the core of the Teach With Databases series, and is available separately. The package also includes the TRI CD-ROM, which contains all TRI data from 1987 to 1992 (more recent data are available through http://www.epa.gov/opptintr/tri), with a corresponding User's Guide, EPA's *Guide to Environmental Issues*, and *Getting Started: A Guide to Bringing Environmental Education Into Your Classroom.*

Can I use *Teach With Databases: Toxics Release Inventory* without a CD player?

Yes. The data necessary for the activities in this package can also be accessed on the Internet at http://www.epa.gov/opptintr/tri.

In which class should I use *Teach With Databases: Toxics Release Inventory*?

Teach With Databases: Toxics Release Inventory can be used in chemistry, Earth science, and environmental education classes. Several activities are also appropriate for those business classes which deal with environmental business decisions. In addition, some of the activities can be used in computer science or math classes as tools for teaching about databases.

How does TRI relate to my community?

Even if there is not a single smokestack or outflow pipe in your community, or your neighboring communities, it is still a part of a watershed and airshed. Chemicals used by facilities hundreds of kilometers away may be brought to your water, ground, and air. *Teach With Databases: Toxics Release Inventory* gives you the tools to locate your watershed and airshed and identify all of the facilities within these areas that must comply with TRI laws. TRI provides extensive information about chemicals which are used and/or produced by those facilities: what they are used for, how long they persist in the environment, their human and environmental health impacts, their LD50, and more. *Teach With Databases: Toxics Release Inventory* also gives you the tools to collect local data, and test for the presence of these, or other chemicals.

Ordering Information

Related Publications from NSTA

NSTA publishes and markets many physical science books. The following publications are related to the topics covered in *Teach With Databases: Toxics Release Inventory*. Click Free NSTA Catalog for more information.

Earth: The Water Planet
Graes 6-10, 1992, revised edition, 204 pp.
# PB076X, $18.50

Project Earth Science: Physical Oceanography
Grades 5-10, 1994, 224 pp.
# PB114X, $21.95

Environmental Science Activities Kit
Michael L. Roa
Grades 7-12, 1993, 330 pp.
# OP283X, $29.95

Field Manual for Water Quality Monitoring
Mark K. Mitchelle and William B. Stapp

Grades 10-12, 1994, 272 pp.
MS082X, $19.95

How to Order *Teach With Databases: Toxics Release Inventory*

Teach With Databases: Toxics Release Inventory is available for only $35.00, with a 10 percent discount for NSTA members. The stock number is #PB143X01.

To order this book online, visit The Science Store, or call **1-800-722-NSTA** between 9 a.m. and 6 p.m. Eastern Time, Monday through Friday. For those outside of the U.S. and Canada, NSTA's main number is **703-243-7100**.

For NSTA membership information, call **1-800-830-3232**.

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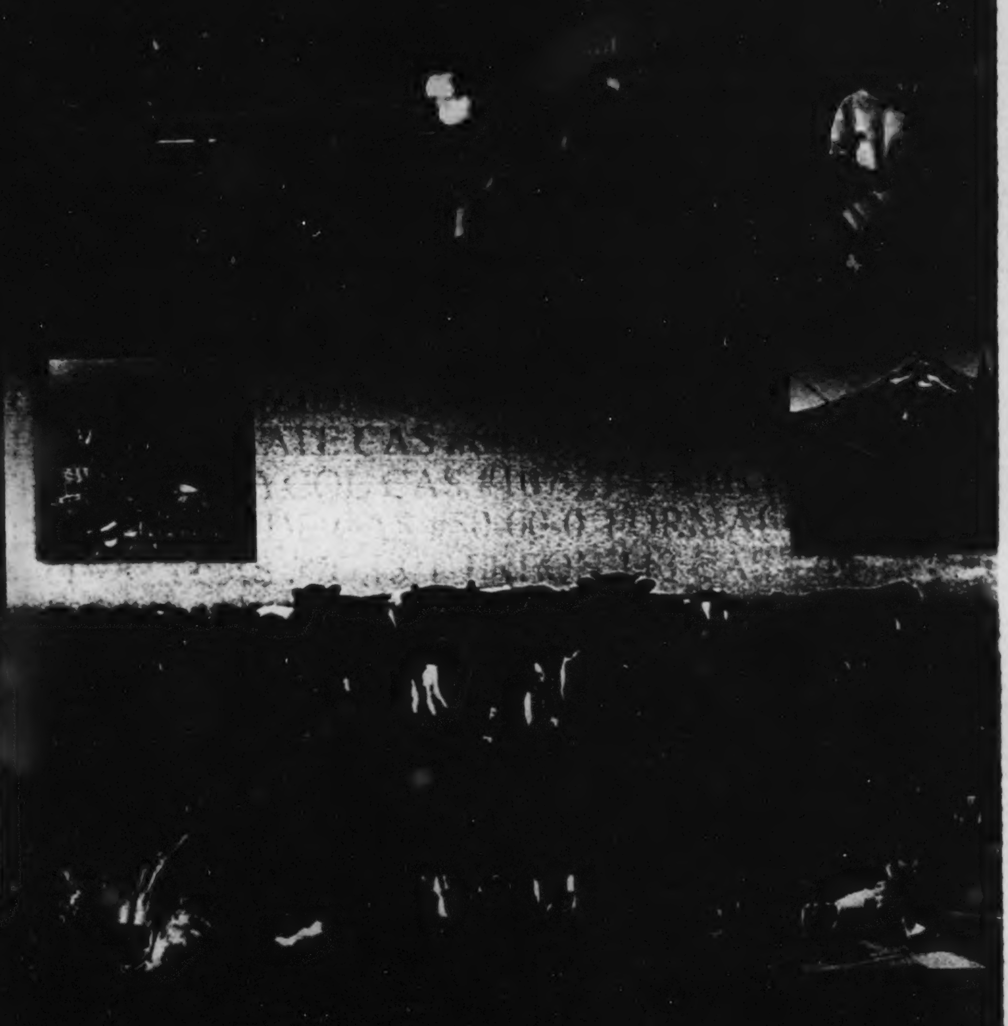
Toxics Release INVENTORY

Activities to
learn about
the chemicals
released
into local
watersheds
and airsheds



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DATABASES

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TEACH WITH DATABASES

TOXICS RELEASE INVENTORY

BY

JAY BARRACATO

PUBLISHED BY
NATIONAL SCIENCE TEACHERS ASSOCIATION
WITH SUPPORT FROM
U.S. ENVIRONMENTAL PROTECTION AGENCY

NSTA Stock Number PB143X01
Library of Congress Catalog Card Number 98-84913

ISBN 0-87355-171-0

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education professionals and has as its purpose the stimulation,
improvement, and coordination of science teaching and learning.

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Introduction to Toxics Release Inventory

Toxics:
Chemicals that adversely affect the health and growth of an organism.

Teach With Databases: Toxics Release Inventory was jointly developed by the National Science Teachers Association and the U.S. Environmental Protection Association (EPA). It has been designed to help science classes take advantage of the wealth of environmental data available in databases, both on-line or in CD-ROM format. The focus is on EPA's Toxics Release Inventory (TRI), with classroom activities which allow students to learn more about the chemicals released into local watersheds and airsheds.

TRI activities are best done with students working with the database in small groups, although each student should have the opportunity to experience using the database on their own. In order to make the best use of one TRI CD-ROM, consider the following options:

- **Put it on a network:** It should be

USING TRI DATA

Many individuals and groups have used TRI during the past decade for a variety of purposes. For example, each of the following entities has used TRI in their own specific ways:

- **GOVERNMENT AGENCIES: Monitor environmental hazards, guide regulatory and legislative decision making.**
- **HEALTH CARE OFFICIALS: Build information databases on toxic chemicals and their effects, to become better prepared in an emergency.**
- **CITIZENS: Monitor environmental dangers. TRI encourages dialog between individuals and local companies on how to improve manufacturing processes to reduce releases. Media reports about TRI have served to inform the public and encourage use of this database.**
- **ENVIRONMENTAL GROUPS: Monitor toxics releases, press manufacturers for changes, promote regulatory action. For example, the Hudson River Sloop Clearwater uses TRI data to track chemical releases in the Hudson River basin. It has produced three reports and undertaken a public education effort.**
- **BUSINESSES: Monitor their releases of toxic chemicals, reduce emissions, and replace toxic chemicals with non-toxic substitutes. Businesses care about their public image; in many cases, manufacturers have substituted non-toxic or less toxic chemicals in order to improve their TRI performance. Many businesses have come to realize that producing and disposing of wastes is a costly undertaking. Producers have thus focused attention on reducing the amount of chemicals they release, and reusing and recycling when feasible.**
- **LABOR ORGANIZATIONS: Inform workers about dangers, press manufacturers for improvements, and lobby for government safety legislation.**
- **ACADEMIC RESEARCHERS: Categorize environmental hazards and devise alternative technologies to prevent toxic spills. Researchers are also coupling TRI data with other data, such as economic indicators, to study social policy and economic development.**

NOTE: As of the writing of this volume, EPA's Toxics Release Inventory database is still recorded in English system units. For ease of use, all references to TRI content have been maintained in this system, though lab preparations and activity sections not dealing directly with TRI are presented in metric units.

possible to place the contents on the CD-ROM on your school's computer network so students can access it from any port. If you have a local network, ask your system administrator for information on installation. EPA has TRI User Support available by telephone; consult the TRI User's Manual for contact information.

- **Order additional CD-ROMs:** EPA makes copies of the TRI CD-ROM available upon request. Consult Section 1.4 of the TRI User's Manual for ordering information.
- **Surf the Web:** The TRI database is located on the World Wide Web at http://www.epa.gov/opptintr/tri. The online database is more up-to-date than the CD-ROM, and the data are presented in an easy-to-read format. However, this database has fewer search parameters than the CD-ROM.

If none of the above options are possible, consider using computer projection equipment. If available, this will allow you to project the computer screen in front of the class, allowing students to follow as you move through the TRI database.

USING TRI IN THE CLASSROOM

This book is designed so that students can use TRI to conduct research into toxics releases in their local communities, and then apply the data to a series of activities that cover biology, chemistry, and environmental science. TRI's strength as a teaching tool is that the data are real, immediate, and of local origin. Your students will come up with both questions and answers that will be different from those found by students in other regions. Sample answers are designed to serve as examples only.

Each unit in this book is based on an independent theme in environmental chemistry. The "First Look at TRI" section will prepare you and your students to use the CD-ROM included with this package. Each of the following units can be used on its own, or in any combination that supports the classroom curriculum. The TRI database also offers an excellent source of ideas for independent student research, and the activities contained in this book may serve as a starting point for student-designed experiments.

This book uses the Chesapeake Bay (page vii) to provide sample context for the use of TRI, and as a location for comparison to your own region or community.

WHY A TOXICS RELEASE INVENTORY DATABASE?

During the past century, rapid industrialization has resulted in the increased use of industrial chemicals. Manufacturers use them in producing petroleum products that run our cars, or chemicals that are sprayed on our crops or used to make the plastic containers that hold our milk and soft drinks. Most products that we use in daily life are produced using chemicals, so they may be necessary; how can we use them safely?

The presence of human-made chemicals in our lives has raised serious safety and health concerns. What are proper exposure levels for workers? What are the impacts when these chemicals are released into the air, water, and ground? These concerns were brought to world attention in late 1984, when an industrial accident occurred at a Union Carbide chemical facility in Bhopal, India. The accident released a toxic gas called methyl isocyanate, killing more than 6,000 people. A short time later, a plant in West Virginia had a serious chemical release. The worldwide outrage over these events focused sharp attention on the issue of public exposure to toxic and hazardous chemicals.

EPCRA'S MAIN PROVISIONS

EMERGENCY PLANNING: Establishes a system on the state and local levels to allow for rapid, effective response to hazardous and toxic chemical releases.

EMERGENCY NOTIFICATION: Requires facilities to immediately notify local and state emergency planning committees if they release a hazardous substance into the environment in amounts that exceed allowable quantities.

COMMUNITY RIGHT-TO-KNOW REQUIREMENTS: Requires facilities to prepare Material Safety Data Sheets (MSDS) on materials they use. The sheets are submitted to state and local emergency planning committees and local fire departments.

TOXICS RELEASE INVENTORY (TRI): Requires facilities to establish an inventory of routine releases of toxic chemicals. The results are placed in a database that is available to the public.

TRI REPORTING REQUIREMENTS

Manufacturing facilities covered by TRI must report:

1. **What chemicals were released into the local environment during the preceding year;**
2. **The type of ecosystem that was contaminated (air, water, land);**
3. **The disposal, treatment, recycling, and energy recovery methods used;**
4. **The methods of chemical treatment used on-site;**
5. **The efficiency of waste treatment;**
6. **Pollution prevention and chemical recycling activities;**
7. **The transfer of chemicals to other facilities.**

In response to the concern these events raised, Congress passed the Emergency Planning and Community Right-to-Know Act (EPCRA) in 1986. The act established requirements for industry and all levels of government, regarding emergency planning and reporting on hazardous and toxic chemicals (page v).

EPA manages TRI, one of the main provisions of EPCRA. It includes more than 600 chemicals that can be released into the air, water, and/or land. Private manufacturers and federal facilities which have more than 10 employees and manufacture or process over 11,312 kg of these designated toxics, must comply with EPCRA. Facilities also must report if they use more than 4,525 kg of any designated chemical or category.

TRI also contains information on pollution prevention and chemical recycling. All information in TRI is part of the public domain—EPA makes the information available to the public in print, microfiche, CD-ROM, and on the Internet.

TRI relies on a system of self-reporting by the manufacturers. Although TRI is currently limited to manufacturing operations, it is being expanded to include more industries and a broader range of chemicals. In accordance with TRI, companies report releases based on estimates rather than exact measurements, and they are not required to report releases smaller than one pound. In addition, the time frames of the releases are not reported either, meaning reported amounts could have been released evenly over the course of the year, or in one single burst.

Most toxics releases result from normal manufacturing of goods or the processing of materials, rather than from accidents. They may occur from refineries processing oil into gasoline, a furniture company producing desks, or other routine commercial activities that provide us with everyday goods and services. Students should understand that local companies and businesses listed in TRI have not necessarily done anything wrong by releasing toxics. A large majority of the toxics releases occur in permissible amounts, and in a manner that complies with environmental laws.

POINT SOURCE AND NON-POINT SOURCE POLLUTION

One important distinction for students to understand is the difference between point source and non-point source pollution. Point source pollution, which TRI covers, comes from easily identifiable, and regulated, sources. For example, point pollution comes from a factory's smoke stack, the discharge pipe of a waste treatment facility, or a leak in an underground storage tank. Environmental regulators can easily determine point sources and measure their emissions. They can also regulate these sources, for example, by requiring advanced scrubbers on smoke stacks, or that underground tanks be more leak proof.

Non-point source pollution comes from many different sources, which are not as easily identified when the impacts are recorded. Oil and other petroleum products may leak from any number of automobiles and other motorized vehicles, and then washed off into the street. Eventually these products may enter local waterways, and possibly the ocean. Other types of non-point source pollution include pesticides and herbicides, which are sprayed locally on lawns and on agricultural fields. Even lawn mowers and backyard grills release some emissions into the air. The variety of sources makes it difficult for regulators to determine the precise location and levels of emissions and, therefore, to pass regulations to limit or prevent them.

When students perform the following activities, they should understand that TRI measures only point source pollution. As a result, they will not be able to determine the full level of pollutants being discharged into a watershed or airshed. In fact, EPA has determined that a major percentage of the existing polluted bodies of water have become contaminated through non-point sources.

THE CHESAPEAKE BAY

The Chesapeake Bay is America's largest coastal estuary. (Please see map on back cover.) Located within Maryland and Virginia, the bay stretches 290 kilometers from near Havre de Grace, Maryland, south to the Atlantic port city of Norfolk, Virginia. Nineteen rivers and approximately 400 streams and creeks flow into the bay, which measures 48 kilometers at its widest point. Three rivers—the Susquehanna, James, and Potomac—provide the bay with about 80 percent of its fresh water. The bay includes numerous fresh and salt water estuaries that are home to many species of fish and wildlife.

The Chesapeake Bay has been used for centuries for commerce, military activities, and recreation. Census projections indicate that 16 million people will live in the Chesapeake Bay area by the year 2000, an increase from 13 million in 1980. Baltimore, Maryland and Norfolk, Virginia are two major port cities, playing host to commercial and military shipping. The bay is rich in fish and marine life, supporting major fishing and crabbing industries—the Maryland blue crab is a well-known delicacy. The city of Annapolis, which is located in the northern area of the bay, is both the state capital and home of the U.S. Naval Academy. On a nice summer day, a visitor will see thousands of recreational vessels as people sail and fish in the bay and its many tributaries.

As commercial and residential development has increased in the region, the Chesapeake Bay has come under increasing stress—the bay is becoming more and more polluted as a result of increasing human activities. This pollution has come from a wide range of sources, including toxics that are released into rivers that flow into the bay; air emissions that become part of rain that falls into the Chesapeake; and pesticide and herbicide runoff from farm fields.

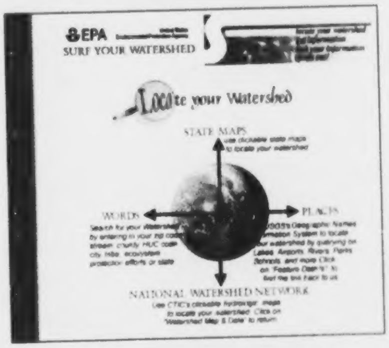
Efforts to preserve the Chesapeake Bay continue, and similar battles are being fought throughout the United States as we struggle to find a healthy balance between human activities and nature. In this book, students will use TRI to understand how toxics are affecting the water and air in their communities.

EPA'S ON-LINE WATERSHED SEARCH PAGE

EPA maintains extensive information about watersheds on its World Wide Web site. The "Surf Your Watershed" page features clickable state maps that allow you to identify watersheds anywhere in the United States. Users can obtain detailed information about the watershed, including a geographic description, maps, population data, land cover statistics, environmental conditions and trends, and discharge information from a host of EPA databases including TRI.

PROCEDURE

1. **Using your web browser, go to the EPA Surf Your Watershed page (www. epa.gov/surf). You will be presented with four search options for identifying a watershed: State Maps, Places, Words, or the National Watershed Network.**



2. **Click on the option with which you are most comfortable. Conduct a search for the watershed in your area.**
3. **The watershed page will include a map and geographical information about the watershed, including population, counties, and nearby watersheds. It will also include a number of environmental indices, including information on toxics releases.**
4. **Click on the TRI link. You will be presented with a page listing all releases of toxics into the watershed. Students can analyze the data to determine the types and amounts of releases into the watershed.**
5. **If the database contains no TRI data for that watershed, then go back to Step 1 and choose another watershed in your area.**
6. **Your web browser will allow you to save the data to your computer or print it out. (A sample map of the Chesapeake Bay is printed on the back cover of this book.)**

ABOUT THE AUTHOR

Jay Barracato considers himself a science teacher. Over the past six years at Patuxent High School in Calvert County, Maryland, he has taught chemistry, biology, Earth science, physics, and environmental science. Jay does independent work at Chesapeake Biological Laboratory on trace level analysis of chlorinated compounds in marine environments, and has involved his high school classes in raising hyperthermophilic *archaea* (bacteria similar to those found at hydrothermic vents). Jay has participated in the Maryland Governors Academy and the University of Maryland Graduate Fellows Program. His students use statistics to analyze real data they collect, and he uses on-line databases as a source of data in his classroom.

ACKNOWLEDGMENTS

Many people helped develop *Teach With Databases*. First, Kathy Hogan of EPA, Ron Slotkin of EPA, Greg Crosby of USDA, Keith Wheeler of Global Rivers Environmental Education Network, and Steve Vandas of USGS provided advice on the content and concepts to be included. Kathy Hogan then designed a survey for science educators, and 92 NSTA members graciously responded with their plans and practices for using on-line data in their classrooms. Kathy Hogan then rounded up the valuable EPA publications included with the *Teach With Databases* package

During the manuscript development, author Jay Barracato received able assistance from reviewers and colleagues, including Rodger Dawson, David Wright, Eileen Setzler-Hamilton, Steve Brown, and Reno T. Nyugen from Chesapeake Bay Laboratory; Marshell Kinnel, Stephen King, Paul Vetterle, and Robert Dredger from Patuxent High School; Michael Szesze, Calvert County Science Specialist; Thomas Wysocki, Crossland High School; Joy Elliott, Gwynn Park High School; and Elizabeth Grumbach, biology and chemistry teacher.

Project advisors and reviewers at EPA's Office of Pollution Prevention were Georgeanne McDonald and Odelia Funke. They coordinated the EPA technical review of *Teach With Databases*, and provided advice and encouragement throughout the development process.

Teach With Databases is published by the National Science Teachers Association, Gerry Wheeler (Executive Director), Phyllis Marcuccio (Associate Executive Director for Publications). *Teach With Databases* was developed and produced by NSTA Special Publications, Shirley Watt Ireton (Director of Special Publications), Chris Findlay (Associate Editor), Anna Marie Gillis (Associate Editor), Michelle Treistman (Assistant Editor), Christina Frasch (Program Assistant). Project Editors for *Teach With Databases* were Christina Frasch for *Database Basics*, and Michelle Treistman for *Toxics Release Inventory*. Michelle Eugeni, Eric Knaub, and Doug Messier also provided assistance. *Teach With Databases* was designed by Sharri Harris Wolfgang of AURAS Design, and printed by Automated Graphic Systems.

Identifying a Local Watershed & Airshed

ACTIVITY 1.1

You may wish to introduce students to database structure and organization by conducting *Database Basics* Activities 1 and 2.

OVERVIEW

This activity allows students to focus on the TRI database by identifying a local watershed and airshed that can be used for subsequent activities. Once students have created a map, they will be able to determine what is released into the watershed and airshed by searching the TRI database by geographical subdivisions (state, county, city), ZIP code, body of water, or other relevant criteria—the TRI CD-ROM database will not perform searches by watershed or airshed.

This activity has two main benefits. First, the map will allow you to take a somewhat abstract concept—the release of toxics—and make it into something real and immediate. (If you are unable to obtain a topographic map, a road map of your specific area will also work.) Students will be able to use this map to determine precisely where a release occurs and to visualize its location on a map. Second, this activity will demonstrate to students that they are part of a larger community. The release of toxics in their area can have an impact many kilometers away, and their community can be affected by events that take place far away. The interconnected nature of life on Earth is an essential concept in biology, chemistry, and environmental science.

Before assigning this activity to students, you will want to identify a local watershed and airshed in your area, and perform a TRI search to determine if there are local manufacturing facilities releasing toxics into the region you identified. If TRI does not have any data for your watershed, or has a small data set, you should then identify another watershed from a nearby city that has industry. For example, a teacher in southern Maryland might find little or no data for the local area, whereas TRI has plenty of information for the city of Baltimore.

A watershed is generally defined as:

- an enclosed basin with a common drainage system
- a basin that forms a part of a larger drainage system
- the water supply for human drinking
- the water supply for farming
- the water supply for all other plant and animal life
- the water supply for cleaning, showering, toilet flushing
- the water supply for manufacturing

An airshed can be any size and shape and is generally defined as an area that you are interested in studying. It has no fixed boundaries, because seasonal variations and disruptive events, such as major storms, will cause an airshed's size and shape to change throughout the year. Airsheds are frequently the area surrounding a watershed. So, for the purposes of this activity, tell students that they are to consider the airshed and watershed to be the same area on their map.

Identifying a Local Watershed & Airshed

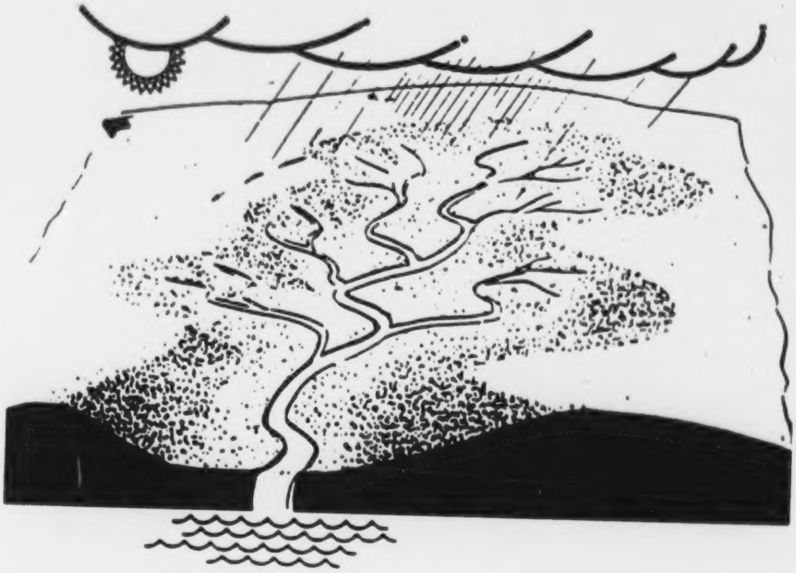
Watersheds come in all shapes and forms, but few are as large or as troubled as the Chesapeake Bay. In this activity, you will define watersheds and airsheds, and identify those in your community. You will then create a regional map, and use it to do the other activities in this book.

PROCEDURE

1. What is a watershed? What is an airshed? Conduct research using books, on-line databases, and maps. Using your research, come up with comprehensive definitions for a watershed and an airshed.

2. Identify a watershed and an airshed in your region. Sources of information include the EPA, United States Geological Survey (USGS), and the United States Department of Agriculture (USDA). You can also speak with USDA Cooperative Extension Service agents, the local department of natural resources, or other experts in your region.

3. Mount a topographical map of your local area on the bulletin board. Cover the topographical map with an acetate overlay so it can be marked with different colored markers.



3. Locate and mark your school on the map. (You may also want to locate and mark your individual homes.) Then, using the information you derive from looking at maps and consulting other resources, draw an outline of your local watershed on the acetate.

4. Identify specific watershed components. Use different colored markers and pushpins to mark them on the acetate overlay.

5. Identify residential and commercial development in the watershed, then mark them on your map or acetate. You can refer to your road and topographic maps—as well as to other resources (such as Geographic Information Systems (GIS) and county planning department maps, phone books, etc.)—to identify and locate major development. You may want to color code the developments by type—such as industrial, commercial, recreational, and residential. How many towns draw water from the river or stream being studied? Where is the intake? Where is the discharge for local water and sewer treatment facilities?

FIRST LOOK AT TRI

In this section, students will use the TRI CD-ROM to obtain an overall understanding of the TRI database and its uses. The first activity asks students to search for toxics releases in their hometown or region. In the follow-up activity, students use the TRI database to learn about the hazards posed by these releases. Extensions at the end of this section ask students how they might redesign the databases to be more useful for residents living near a manufacturing facility.

SECTION 2 GOALS

2.1

FOCUS

TRI is the citizens' resource for determining which toxic chemicals are released into the community. This section provides the tools necessary for using TRI.

OBJECTIVE

To become familiar with the types of data and the database tools used in TRI.

2.2

FOCUS

Each chemical included in the TRI database has a Chemical Substance Fact Sheet. These provide crucial information, for citizens as well as health and safety professionals, about the chemicals.

OBJECTIVE

To search TRI for specific Chemical Substance Fact Sheets. To learn about chemicals in local areas.

Identifying Toxics Releases in a Region

ACTIVITY 2.1

You may wish to introduce students to data analysis and basic statistics methods by conducting *Database Basics* Activities 6 and 7.

This activity can be used in concert with Activity 1 or on its own. This exercise leads naturally into Activity 2.2, in which students will learn what toxics are being released into the area they have chosen.

This activity uses a map and pins. An alternative would be to use a laminated map and alcohol pens to mark release locations.

As with Activity 1, you should conduct the search prior to leading the class in this activity. This will allow you to become familiar with the database, and ensure that the area your class will search has TRI listings—some communities are not covered by TRI.

If you expand the search to cover the entire watershed, you might want to use maps that include ZIP codes. It is likely that many watersheds will only cover parts of counties or cities. Having a ZIP code map could help students to narrow the search considerably.

Answers will vary by area.

EXTENSIONS

1. Ask students to search TRI's treatment database. Identify how manufacturers are treating toxics and managing their waste flow.

2. Have students broaden or refine the search as desired. Possible options include:

a. Expand the search to include the entire watershed you identified in Activity 1. You can do that by searching any additional areas (by town, county, or ZIP code) not included in the original search. You can then combine those results with the rest of the data you collected by using Step 6.

b. Narrow the search by type or category. For example, you could identify only water releases that take place in your study area. Or, you could limit it to a particular chemical such as styrene or chloroform.

Identifying Toxics Releases in a Region

In this activity, you will use the TRI database to investigate which chemicals are being used by manufacturing facilities in a specific area. In the process, you will learn the basics of searching a database.

PROCEDURE

1. Determine a geographic area that you want to search. If this is the watershed or airshed you identified in Activity 1, then choose a county or city located within this area. If you did not do Activity 1, then choose a city or county that you live in or near.

2. Obtain a map of the area that you are searching and place it on a bulletin board. This activity works best if you have a street map of the area.

3. From the main TRI menu, choose the TRI 1987-1990 database. (Make sure you have the CD-ROM in the drive.) Choose **Release** when prompted. This will allow you to search for toxics released during this time period.

4. Under **Select**, conduct a search for toxics releases in the area you have chosen. Scroll down to **Facility City** or **Facility County** and hit return. Type in the name of the city or county you are searching. The computer should show a tally of toxics releases in that area.

5. Under **Select**, choose **Facility State** and type in the name of the state in which the county or city is located. The computer should show a tally of toxics releases for your state.

6. Choose **Combine Sets** and type in "1" and "2" to combine the two searches. This combined list will have the number of toxics releases for the city or county you searched.

7. To display the information, choose **Sets** and then scroll down to **Display Sets**. Type in the number "3" and hit return. You should see the first record in the combined list.

8. Scroll through the records. (Print them out if that makes them easier to examine.) Which chemicals were most frequently released? Where were the releases occurring? Did they increase or decrease over the years? What other patterns do you see?

9. Using pins, mark on the map where releases occurred in the community you are studying. You could use colored pins to designate different types of releases (air vs. water) or the releases of specific chemicals.

10. Look for patterns in the data. Are the releases clustered in particular areas? Do specific types of facilities release particular toxics? Are there more water than air releases? What other trends do you see?

QUESTIONS

1. Analyze the results of your search.

a. Are the releases evenly distributed, or localized in specific areas?

b. What bodies of water are being affected by discharges?

c. Are the areas where many releases take place heavily or lightly populated?

Learning More About a Toxic Chemical

Depending on the number of chemicals identified in Activity 2.1, you may wish to have students perform a second search of additional areas, thus increasing the number of chemicals they can research for this activity. If possible, ensure that no two students research the same chemical. Answers will vary by chemical.

EXTENSIONS

1. Chemical Substance Fact Sheets are written primarily to cover workplace exposure. Ask students to rewrite the sheets considering the following questions about the impact of releasing the chemicals. How large of a concentration would be needed to cause serious injury or death? How is the chemical diluted in open air or water?

2. Every facility that reports TRI data is required to have a contact who can answer questions from the public. Invite the Public Information Officer from a local manufacturing facility to visit class to discuss TRI. Other sources of information include your local fire department, emergency planning committee, or a union that represents workers at a local facility.

3. Research one chemical found in your area, and write a report which documents the history of the chemical—how it got there, what are the associated health and environmental impacts, what is the local response, and how is it being dealt with.

ACTIVITY 2.2

If students will be writing reports on a specific chemical, you might want to first introduce them to data graphics using *Database Basics* Activity 9. You might also introduce toxicity and measurement with *Database Basics* Activities 4 and 5, and TRI Activity 6.1.

Learning More About a Toxic Chemical

In Activity 2.1, you learned about the release of chemicals in your home area. The information you used, however, did not tell you very much about the chemicals involved or the dangers they pose. Fortunately, the TRI database includes Chemical Substance Fact Sheets that contain extensive health and safety-related information for each of the compounds on the EPA's toxic substance list. The fact sheets provide information about toxicity, acceptable exposure levels, health effects, protection methods, and other important matters. You can use the data to learn more about chemicals released in your community.

In this activity, you will use the fact sheets to study one of the chemicals you identified in Activity 2.1.

PROCEDURE

1. Choose a common chemical from the list of chemicals you found in Activity 2.1.
2. From the main TRI menu, choose Chemical Substance Fact Sheets.
3. Type in the name of the chemical you want to research and hit return.
4. Review the information on the fact sheet.
5. Answer the Chemical Substances Questionnaire.

CHEMICAL SUBSTANCES QUESTIONNAIRE

1. Which chemical did you select?

2. What is one non health-related hazard associated with this chemical?

3. What is the workplace exposure limit?

4. What is the difference between an acute health effect and a chronic health effect?

5. What are the health hazards associated with the chemical?

6. What personal protective equipment should be worn when working with this chemical?

7. What is the most common treatment method for the chemical?

QUESTIONS

1. Examine the Chemical Substance Fact Sheets from different perspectives. How might a factory employee use the data? A plant manager? The director of the local emergency response committee? A local fire chief? A paramedic?

2. How you would rewrite the fact sheets so that they would be useful to a person living near the facility? What sorts of information would they need? How would you obtain it?

RELEASES

SECTION 3 GOALS

3.1

FOCUS

The main purpose of the TRI database is to tabulate the releases of hazardous chemicals by industry into the environment. To understand the chemistry of the environment, you need to determine the amount and identity of the chemicals added to the environment by humans.

OBJECTIVES

To use TRI to locate sources of point and non-point pollution in your community. To find trends in chemical releases by tabulating, summing, averaging, and graphing chemical releases.

3.2

FOCUS

Engineers often use the Law of Conservation of Mass to determine the amount of chemicals released into the environment.

OBJECTIVE

To demonstrate the Law of Conservation of Mass by analyzing a reaction in a closed system.

3.3

FOCUS

Sulfates persist in many aquatic habitats. Careful chemistry can reveal trace levels of this ion.

OBJECTIVE

To analyze samples for trace levels using spectrophotometry.

3.4

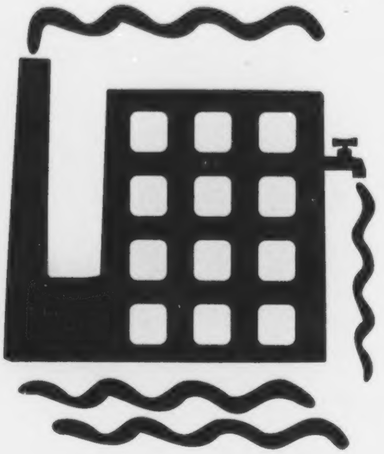
FOCUS

The chloride ion is prevalent in different water sources throughout the environment. Careful chemistry can reveal how much is present.

OBJECTIVE

To use the technique of titration to determine the amount of solute present in a sample.

Students may wonder how manufacturers determine how much of a chemical they are releasing. In some cases, facilities can directly measure their emissions by monitoring their solid and liquid wastestreams. In other instances, manufacturers use mass balances as an estimation method. Mass balances are based on the Law of Conservation of Mass, which states that mass cannot be created or destroyed in an ordinary chemical reaction. In essence, if a manufacturing plant creates a chemical reaction and ends up with less mass than they expect, they have "lost" something along the way. The lost material is an emission that the manufacturer must report to EPA.



Sulfuric acid is an excellent example. It is a primary product of the chemical industry, and a byproduct of its production, sulfur dioxide, is a main cause of acid rain. The scientific equation for producing sulfuric acid is shown in Figure 3.0: (a) Sulfur (S_8) is burned to form sulfur dioxide (SO_2); (b) the sulfur dioxide is converted by a catalyst to sulfur trioxide (SO_3); and, (c) the addition of sulfur trioxide to water forms sulfuric acid.

Using these equations, engineers working for the manufacturer can predict how much sulfuric acid can be made from the amount of sulfur used. Sulfuric acid is 33 percent sulfur by mass. The production of 1 kilogram of H_2SO_4 requires 330 grams of sulfur. If the facility uses 330 grams of sulfur but only produces 950 grams of H_2SO_4, where did the remaining 50 grams go? Plant workers assume that the 50 grams of sulfur was lost to the air in the form of SO_2 or SO_3, both of which are gases. These gases must be reported to EPA as a release. EPA is concerned about these releases because they can have an impact on the environment. SO_2 is oxidized in the atmosphere into SO_3, which causes the formation of H_2SO_4. This compound contributes to acid rain, which pollutes the environment.

POINT SOURCE POLLUTION

Pollution that can be directly measured at its source. Examples: Smokestack emissions, and direct discharges from facilities into rivers and streams.

NON-POINT SOURCE POLLUTION

Pollution that comes from many different sources, and cannot be easily measured at its source. Examples: Chemical runoff from farm fields, and emissions from automobiles.

FIGURE 3.0

a. $S_8(s) + 8O_2(g) \rightarrow 8SO_2\ (g)$

b. $2SO_2\ (g) + O_2(g) + \text{catalyst} \rightarrow 2SO_3\ (g)$

c. $SO_3\ (g) + H_2O \rightarrow H_2SO_4$

Toxics Trends

ACTIVITY 3.1

Before conducting this activity, you may wish to use *Database Basics* Activity 8 to introduce students to graphing techniques. This activity also presents an opportunity to introduce students to decision-making. *Database Basics* Activity 10 in conjunction with the third extension suggestion can help students draw connections between data collection and real-world problems.

The main purpose of this exercise is to allow students to learn more about data analysis by looking at a specific chemical released into the environment. This activity requires at least 40 total releases for the eight years, so students may need to expand the search beyond the original search area.

EXTENSIONS

1. Have students survey their home for sources of point and non-point pollution.

a. What happens to your waste water? Where does it go?

b. What energy source heats your home? Where is it stored? What, if any, emissions does it produce?

c. How do you dispose of solid waste, such as trash? Where does it go?

2. Have students research the history of their community in regards to laws regulating sewage and other waste removal. Have the laws changed? If they had lived in their home 10, 25, or 50 years ago, how would their answers to Extension 1a, b, and c change?

Toxics Trends

In this activity, you will analyze the results of your earlier watershed search to learn about trends in toxics releases. You will find total and average releases for a particular chemical over an eight-year period.

PROCEDURE

1. Use the procedures stated in Activity 2.1 to search for the release of chemicals in your local watershed or area. Identify the toxic chemical most often released in that area. This activity works best if you have a data set with 20 to 40 releases. If the total number is below 20, you might want to expand your search area; if over 40, narrow your search.

2. Display the data sets by Reporting Year.

4. Analyze the records to determine which type of ecosystem—air, water, land, or underground—has had the greatest amount of chemicals released. Label your first data chart (Table 3.1) with that type. Label the second data chart (Table 3.2) with total releases. For each year and facility, complete the data chart with the amount released from the TRI data.

5. For each year, total the releases and find the average releases per facility.

6. Repeat your search in the 1991-1993 TRI, again obtaining data on 20 to 40 releases of the chemicals. Add these data to your data chart. You should have between 40 and 80 data points on each of your data tables as well as eight yearly totals and eight yearly averages.

7. Graph the year vs. the total releases (Graph 3.1) and the year vs. the average releases (Graph 3.2).

8. Express the release by type as a percentage of the total releases.

Percent of ____________________ released to the ____________________.
(chemical name) (type of release)

	1987	1988	1989	1990	1991	1992	1993	1994
Sum of (air, water) releases								
Sum of all releases								
Percent								

ANALYSIS QUESTION

1. How does the percentage of the chemical released by type change over time?

TABLE 3.1

Data Table for Releases of ______________ into ______________ by year.

(chemical name) (type of release)

FACILITY.	1987	1988	1989	1990	1991	1992	1993	1994
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
Total								
Average								

ANALYSIS

1. What year has the maximum total release? How much was released?

2. What year has the minimum total release? How much was released?

3. What year has the maximum average release? How much was released?

4. What year has the minimum average release? How much was released?

TABLE 3.2

Data Table for Releases of ______________________ by year.
(chemical name)

FACILITY	1987	1988	1989	1990	1991	1992	1993	1994
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
Total								
Average								

ANALYSIS

1. What year has the maximum total release? How much was released?

2. What year has the minimum total release? How much was released?

3. What year has the maximum average release? How much was released?

4. What year has the minimum average release? How much was released?

GRAPH 3.1

Graph of Total Releases of ______________________ **into** ______________________.
(chemical name) (type of release)

ANALYSIS QUESTION

1. Describe any trends evident in your graph.

GRAPH 3.2

Graph of Average Releases of ______________________ into ______________________.
(chemical name) (type of release)

ANALYSIS QUESTION

1. Describe any trends evident in your graph.

Conservation of Mass

ACTIVITY 3.2

You may wish to conduct *Database Basics* Activity 3 to explore sources of error in a survey and/or data set. *Database Basics* Activity 4 can be used to help prepare students for working with titrations and dilutions. Additionally, you may wish to introduce mass and scales with *Database Basics* Activity 5.

This activity is designed to model the procedure most commonly used in determining the amount of material released by industries. The products of the reactions include precipitates and a gas. It should be noted that the reaction most likely to lose mass is the one that produces a gas. Gases are the hardest phase of matter to contain, and many of the releases that occur during the manufacturing process happen when the materials are in the gas phase.

Each reaction consists of a solid reagent and a solution. These are:

0.1 M hydrochloric acid (HCl) (8 ml conc. HCl diluted to 1 L) and solid sodium bicarbonate (Na_2CO_3)

0.1 M lead nitrate ($(PbNO_3)_2$) (33.1 g diluted to 1 L) and solid potassium iodide (KI)

0.1 M silver nitrate ($AgNO_3$) (17 g diluted to 1 L) and solid sodium chloride ($NaCl$)

Be sure to dispose of lead nitrate and silver nitrate properly.

ANSWERS TO QUESTIONS

1. Mass cannot be created or destroyed in ordinary chemical reactions.

2. In a reaction, atoms are neither created nor destroyed, but they may be rearranged into new molecules.

3. Yes, the Law of Conservation of Mass is proven, because although there was a change in the phase of matter, there was no change in overall mass. This is shown by the almost zero percent change. (Small changes may be attributed to error in measurement.)

4. Gases are the most difficult to contain.

5. It doesn't tell exactly how the material was released or into what waste stream. Industries would have to monitor amounts at every step in a manufacturing process.

EXTENSIONS

1. As an out-of-class, or extra credit assignment, have students learn about EPA Superfund sites.

a. What are they?

b. What chemicals contaminate them?

c. What methods are being used to clean them?

d. Are there any sites near your home or school?

2. If there is a Superfund site near your home, invite a local EPA representative to speak to your class.

a. What is the history of the site?

b. What chemicals are present in the site?

c. What has been, and is being, done to remediate the site?

d. Can the site be used in the future? If not, why?

3. Have students use the TRI database to locate 10 nearby manufacturers, and compare their emissions in terms of states of matter. Do the companies release higher levels of solids, liquids, or gases? Ask students to graph their findings using stem-and-leaf plots, line graphs, or pie charts. (Instructions for these data analysis methods are in *Database Basics* Activity 7.)

Conservation of Mass

In this activity, you will explore the principle of mass balance. The principle is based on the Law of Conservation of Mass, which states that mass cannot be created or destroyed in an ordinary chemical reaction." Manufacturers use similar procedures to estimate chemical releases from their facilities when direct measures are not possible.

MATERIALS

Ziplock bag
Medicine cup
Scale
Reagents and solutions

PROCEDURE

1. For each reaction, place the liquid in the medicine cup and the solid in the bag. Place the medicine cup inside the Ziplock bag so it will not spill. Seal the bag.
2. Weigh the Ziplock bag and its contents as precisely as possible. Record the mass.
3. Spill the medicine cup so the compounds mix and react. Be sure the bag remains sealed.
4. Weigh the Ziplock bag again.
5. Calculate the percent change in mass for each reaction.

REACTIONS

$HCl\ (aq) + Na_2CO_3\ (s) \rightarrow$

$Pb(NO_3)_2\ (aq) + KI\ (s) \rightarrow$

$AgNO_3\ (aq) + NaCl\ (s) \rightarrow$

STUDENT DATA REPORT: Conservation of Mass

REACTION	STARTING MASS	FINISHING MASS	CHANGE IN MASS	PERCENT CHANGE
$HCl + Na_2CO_3$				
$Pb(NO_3) + KI$				
$AgNO_3 + NaCl$				

QUESTIONS

1. State the Law of Conservation of Mass in your own words.

2. Explain the Law of Conservation of Mass on a molecular level.

3. Do your results prove the Law of Conservation of Mass? Why or why not? (Hint: how much of a percent change did you get?)

4. Which phase of matter is the most difficult to contain?

5. What are the possible shortcomings in this method for estimating chemical emissions from manufacturing facilities? What could industry scientists do differently?

Determination of Sulfates in Aquatic Habitats: Spectrophotometer Model for Trace Level Analysis

This activity requires the collection of environmental samples. You can collect these samples yourself, using the sample description in the Student Section as a guide, or you can involve students in the collection process.

A calibration curve is needed for this Activity. Depending on your class size and available time, you should either prepare a curve prior to class, or have students perform this task as part of the activity. The standard solutions of sulfate ion can best be made by the following series of dilutions:

1000 ppm = 1000 mg/L SO_4^{2-}, the molar mass of $SO4^{-2}$ is 96 g/mole

1000 mg/L SO_4^{2-} = 1000/96 = 1.04×10^{-2} mole SO_4^{2-}/L

if the standard solutions are made from Na_2SO_4, then

1.04 x 10-2 mole Na_2SO_4 (142 g/mole) = 1.48 g Na_2SO_4

Make the standard solution by adding 1.48 g of Na_2SO_4 to 1.0 L of water. This standard solution can be diluted to give stock solutions, ranging from 100 to 1000 ppm.

ANSWERS

1. $Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4$

2. To compare the unknown concentration with known values.

3. No it should not. The calibration curve may not stay linear.

4. Either collect more points to extend the calibration curve, or dilute/concentrate the sample to be in the range of the curve.

5. To remove suspended particles that would interfere with the measurement.

6. Sample answer: 500 ppm = 5×10^{-7} g/L = 5.2×10^{-9} moles/L.

EXTENSIONS

1. Have students research the area from where the environmental sample was taken. If they accompany you to collect the sample, have them record information about the site. For example, what does the water look like? What kind of vegetation is growing near the water? Are there buildings or roads nearby? If they do not accompany you, or if the site is too far for them to visit on their own, have them look up that area in the TRI database. Can the presence of sulfates, or lack thereof, be related to any toxics that are being released in that watershed? Why, or why not?

2. Ask students to use the TRI database to identify all companies that release a particular chemical. Have students contact one of these companies. What equipment do they use to test their emissions for that chemical? Do they test samples from their surrounding environment? How do the companies determine between the chemical not being present in their emissions and when it is present in levels that they cannot detect?

ACTIVITY 3.3

Before conducting this activity, you may wish to use *Basics* Activity 4 to introduce chemical detection, relative concentration, dilutions, toxicity, parts per million, and data indicators. To teach students how to plot data, and determine line equations, you may wish to use *Database Basics* Activity 7, Appendix C, or the section on "Finding the Line of Best Fit" in Appendix A.

Model for Trace Level Analysis: Concentration of Sulfate in Environmental Samples

INTRODUCTION

The spectrophotometer is an instrument found in many chemistry labs. It operates on the principle that chemical solutions absorb light. When the isolation is placed in a test tube which is then placed in the instrument, light of a known wavelength passes through the solution and onto a detector; and the detector tells us either the amount of light absorbed or transmitted by the sample.

The amount of light absorbed by the sample is related to its concentration: this is known as Beer's law. At low concentrations, this relationship is linear. A typical way of using the spectrophotometer to provide quantitative data involves creating a calibration curve. Samples of known concentrations of the compound of interest are carefully made, the absorbency is measured, and the data are graphed to determine the equation of the line. A sample of unknown concentration is then measured for absorbency, and the concentration is determined by comparing the line of the unknown to that of the known concentration.

TRACE LEVEL ANALYSIS

For many years, the common attitude toward chemical releases was: "The solution to pollution is dilution." Many engineers and scientists believed that the great amount of water flowing through the rivers was sufficient to dilute chemical waste to the point of harmlessness. However, scientists have discovered that this is not necessarily true.

The Baltimore Inner Harbor is an excellent example. This area, once full of factories and warehouses, has been redeveloped into a popular recreational area. It now includes an aquarium, shops, restaurants, and other attractions. But, if you visit the Inner Harbor, you will notice that not all the property has been redeveloped. For example, there is a large factory site near the center of the Inner Harbor that is still vacant.

You might suspect that this property is worth millions of dollars. However, during World War II, this was the site of a metal factory that produced alloys of chromium, a toxic substance that makes redevelopment difficult. The soil on this site is still heavily contaminated. Large amounts of chromium were also dumped into the harbor, where it remains buried in the sediment today. When these soils and sediments are disturbed by drilling or dredging, the chromium is resuspended in the water.

Scientists who monitor the harbor need to accurately measure very low levels of these concentrations. This process is referred to as trace level analysis. Scientists use a series of units to express these very low concentrations:

Parts per million (ppm) - number of milligrams of contaminant per liter of water

Parts per billion (ppb) - number of micrograms of contaminant per liter of water

Parts per trillion (ppt) - number of nanograms of contaminant per liter of water

Let's say a scientist finds that a local pond has a concentration of mercury that is 10 ppm. To picture this small amount, imagine one million jelly beans. If the red ones represent mercury, there would only be 10 red jelly beans in the entire pile. Trace level analysis requires careful work by the scientist, as samples from the environment could easily be contaminated in the laboratory. In addition, scientists need to be constantly aware of their level of detection, the lowest amount they can detect. This is especially important if the level of detection is greater than the level at which a chemical has adverse affects. They must determine if their equipment is sensitive enough to detect harmful levels of a certain chemical. For example, a method which detects metals only in the ppm range, is of no use if a metal is present in the ppt range.

Trace level analysis is important because it serves as a model for the relative concentrations that these releases create. Students are not used to dealing with these extremely small numbers. Activities 3.3 and 3.4 help reinforce the difference between a "nondetect"—meaning the chemical is present, but the equipment is not sensitive enough to detect it—and the chemical substance actually not being present.

Determination of Sulfates in Aquatic Habitats: Spectrophotometer Model for Trace Level Analysis

An environmental sample was collected from a river. The water was allowed to settle and was filtered to remove any insoluble particles.

PROBLEM

What is the concentration of sulfate in the environmental sample measured in ppm?

MATERIALS

Spectrophotometer
Curet
20 ml environmental sample
0.06 g barium chloride ($BaCl_2$)

PROCEDURE

1. Turn the spectrophotometer on, then allow it to warm up for 15 minutes. Next, adjust the wavelength to the desired value. For this activity, it should be set at 500 nm. With the door closed and nothing in the chamber, adjust the left knob until the needle reads 0. Place a curet filled with distilled water into the chamber (the outside of the tube should be clean and dry). Adjust the right knob until the dial reads 100. The instrument should be ready to take your measurements.

HINT: Take as many measurements at once as you can. If someone else uses the instrument, it must be zeroed again.

2. Create a calibration curve to compare your unknown samples to a series of known samples. In this activity, the calibration curve should be created by making a series of sulfate ion (SO_4^{2-}) solutions, and measuring their absorbance in a spectrophotometer. The absorbance is linear with the concentration over the range of samples in this activity—the concentration is graphed on the independent axis, and absorbance is graphed on the dependent axis. The best fit line is drawn or determined algebraically, and the concentration of the unknown sample is determined by measuring the absorbance in the spectrophotometer and interpolating from the graph.

3. Prepare your environmental sample by adding 0.06 g $BaCl_2$ to 20 ml of it. This forms the white precipitate that you will be measuring. Stopper the curet and shake three times to evenly mix the $BaCl_2$. Measure the sample in the spectrophotometer.

STUDENT DATA REPORT: Sulfates

Sample calculation for determining mass necessary for the standard solution:

100 ppm SO_4^{2-} is 100µg/L SO_4^{2-}

Assigned standard solution ____________________

Calculate the mass of assigned concentration:

CLASS DATA FOR STANDARD SOLUTIONS

CONCENTRATION	ABSORBENCY	CONCENTRATION	ABSORBENCY
50 ppm		450 ppm	
100 ppm		500 ppm	
150 ppm		550 ppm	
200 ppm		600 ppm	
250 ppm		650 ppm	
300 ppm		700 ppm	
350 ppm		750 ppm	
400 ppm		800 ppm	

The data should be plotted on graph paper, showing concentration vs. absorbency. Determine the equation of the line.

Equation of the best fit line ____________________

Correlation coefficient ____________________

COLLECTION POINT #1	COLLECTION POINT #2
SAMPLE ABSORBANCY	**SAMPLE ABSORBANCY**
1	1
2	2
3	3
Average	Average

Calculate the concentration of the sample from the equation of the calibration curve.

Concentration ____________________ Concentration ____________________

QUESTIONS

1. Write a balanced equation that describes the reaction of the sulfates and the barium chloride.

2. Describe the purpose of a calibration curve.

3. Can the calibration curve be used to determine points that are larger than your highest point or lower than your lowest point? Why or why not?

4. If the absorbency of the unknown is not within the limits of your calibration curve, what should you do?

5. Why must the environmental sample be filtered before processing?

6. Express the concentrations of the sulfate ion determined in the lab as molarities (moles/liter).

Determination of Chloride in Water: Titration Model for Trace Level Analysis

This activity requires the collection of environmental samples. You can collect these samples yourself, using the "Background" part of the Student Section as a guide, or you can involve students in the collection process. The sample should be filtered to remove any suspended materials.

A silver nitrate solution and fluorescein indicator are required for this activity. A 0.001 M $AgNO_3$ solution can be made by adding 0.17 g $AgNO_3$ to 1 L distilled water, and should be used if the environmental sample is fresh water. (See Extension 1.) The fluorescein indicator can be made by adding a small pellet of solid fluorescein to 100 ml of a 50% water/methanol solution.

Be sure to dispose of silver nitrate properly.

ANSWERS

Calculations:

1. Answers will vary according to sample. Total salt can be determined from the mass remaining after evaporation and the initial volume of the sample.

2. Answers will vary according to sample. The chloride ion may be determined by:

$(M\ Ag)\ (ml\ Ag) = (M\ Cl)\ (ml\ Cl)$.

3. Answers will vary according to sample. Molarity may be converted to mass using the molar mass of Cl, 35 g/ml.

4. Answers will vary according to sample. Use answers from questions 1 and 3 to calculate the percentage.

Questions:

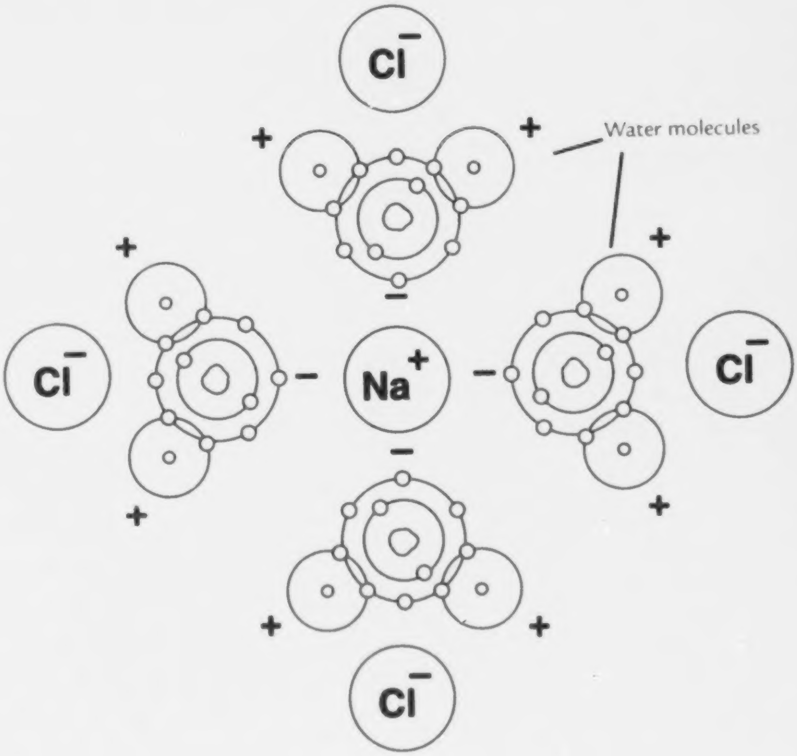
1. $AgNO_3 + Cl^- \rightarrow AgCl + NO_3^-$

EXTENSIONS

1. If possible, have students collect additional samples from different ecosystems—estuarine and marine—and test them along with the fresh water environmental sample. A 0.1M $AgNO_3$ solution should be used for salt water, and can be made by adding 17 g $AgNO_3$ to 1 L distilled water.

2. Ask students to identify and summarize any trends that exist between the location of the sample, the amount of total salt, and the amount of chloride ion present in each sample.

Determination of Chloride in Water: Titration Model for Trace Level Analysis



Sea water is a complex mixture of many dissolved substances, the most abundant of which is sodium chloride (NaCl). A measurement of the chloride ion, therefore, can serve as a good indication of the total amount of salt in water. In this lab, we will use Fajens titration to compare the amount of chloride with the total amount of dissolved solids in an environmental sample. This titration process is one type of analysis that can be used to identify trace levels of released chemicals in solid and liquid samples.

PROBLEM

Describe the amount of chloride in an environmental sample as a percentage of the total dissolved solid.

MATERIALS

75 ml beaker
Oven, burner, or hot plate
Buret
Fluorescein indicator
$AgNO_3$ solution

PROCEDURE

1. Record the mass of a 75 ml beaker. Pour about 50.0 ml of the environmental sample into the beaker, and record the exact amount. Label the beaker.

2. Using either the oven, burner, or hot plate, evaporate the solution. Remove the label after the beaker has cooled down, and record its mass.

3. Place an amount of the sample, as determined by your teacher, in a small flask. Add 5 drops of fluorescein indicator.

4. Record the concentration of the $AgNO_3$ solution, and place it in the buret. Titrate the sample until a color change is evident. Do not over titrate. Record the volume of $AgNO_3$ you used.

5. Repeat steps three and four.

STUDENT DATA REPORT: Chlorides

	SAMPLE 1	SAMPLE 2	SAMPLE 3
Mass of Beaker			
Mass of beaker + salts			
Total mass of salts			
Amount evaporated (ml)			
Trial 1			
Amount of water			
Amount of $AgNO_3$			
Trial 2			
Amount of water			
Amount of $AgNO_3$			

CALCULATIONS

1. Calculate the concentration of the total salt content in grams per liter.

2. Calculate the concentration of the chloride ion in moles per liter.

3. Convert the molarity of the chloride ion into grams per liter.

4. Express the concentration of the chloride ion as a percentage of the total dissolved solids.

CONCLUSIONS

	ENVIRONMENTAL SAMPLE
Concentration of total solids in grams/liters	
Concentration of chloride in moles/liters	
Concentration of chloride in grams/liters	
Percentage of chloride in total solids	

QUESTIONS

1. Write a balanced equation describing the reaction between the chloride ion and the silver nitrate.

TRANSPORT

Scientists often refer to water as the universal solvent because so many chemicals are soluble in it. This solubility allows many chemicals to move in dissolved forms through ecosystems. A toxic chemical released into a stream by a manufacturing facility can be washed into a river, and eventually be detected in a bay many kilometers away. We can never be sure where the final resting place for chemicals released into the environment may be, or how long it may take for them to get there.

How fast a chemical moves through the environment is called its rate of transport. Chemicals with high rates of transport move extremely far in short amounts of time. Other chemicals move more slowly from their release sites. Because the rates of chemical movements vary, it is often difficult to predict how much of a a chemical may be found in its area of origin, or anywhere. A chemical's rate of dispersion, however, depends partly on the size of the area into which it has been released. The same chemical released into two different watersheds will have the same rate of transport and, therefore, will travel at the same rate through each watershed. However, the chemical will disperse more quickly through the smaller watershed because it has less distance to travel, and will "fill" the smaller area faster.

In this activity, students study the rate of the transportation of chemicals through the watershed they identified in Activity 1.1.

SECTION 4 GOALS

4.1

FOCUS

Pollution almost never stands still. Water carries many chemical passengers as it moves through its own cycle. These chemicals, both harmful and harmless, may end up miles from their sources. The major polluter of your neighborhood may not even be located in your state.

OBJECTIVES

To describe how chemicals move through the environment. To apply the concepts of a water cycle and solubility to an environmental problem.

4.2

FOCUS

What chemicals are moving through your local watershed, river or stream?

OBJECTIVE

To estimate the transport of chemicals using TRI data and chemical fact sheets.

4.3

FOCUS

Oxygen is critical to most life on Earth. In an aquatic ecosystem, the amount of oxygen present depends upon many factors, including the temperature of the water, the amount of oxygen produced by living organisms, and the amount of oxygen used by these organisms. The amount of dissolved oxygen is often used as a measure of the overall health of an ecosystem.

OBJECTIVE

To estimate the health of an aquatic organism by measuring the dissolved oxygen and the basic oxygen demand.

Modeling the Processes of Chemical Transport

ACTIVITY 4.1

An alternative procedure is presented in *Database Basics* Activity 4, which introduces indicators, detection, and detectability of various substances in a solution. You may also wish to conduct *Database Basics* Activity 6 to familiarize students with statistical descriptions. Activity 7 also provides students with techniques for plotting their data.

The air transport part of this activity requires the use of a fragrance, such as a perfume or fruit extract; several can be tested. For water transport, you will need food coloring.

The groundwater transport part of this activity requires some set-up time. The recommended soil types can be purchased at a hardware store or greenhouse. If you do not have stream tables, they can be made from aluminum gutter, available at local hardware stores, or from paint roller trays which have a minimum depth of 2.5cm. Place several long, thin slits at different heights along the lower side of the tray to allow water to exit. Ignore ladder clamps, if any.

ANSWERS

Air

1. Smaller, lighter chemicals move the fastest through the air. Because chemicals diffuse, the rate in any direction may be smaller than the actual movement of the chemical.

2. The larger the airshed, the longer it will take for a compound to completely disperse through the system.

Water

1. The rate of transport is affected by the solubility of the compound in water, and the rate of movement, or mixing, of the water.

2. It takes longer for a compound to disperse through larger watersheds.

3. Location determines where and how fast the chemical will travel. A chemical released upstream of a populated area will have a drastically different impact than one released downstream.

Groundwater

1. The faster groundwater moves, the faster the chemicals are transported.

2. Chemicals are transported through the ground by water. Without water, they would move very slowly, if at all.

3.Location, topography, and geology determine the route the chemical will follow as it moves through the ground, and therefore what it will impact.

EXTENSIONS

Have students research the following topics:

1.Which agricultural methods may affect the movement of surface water?

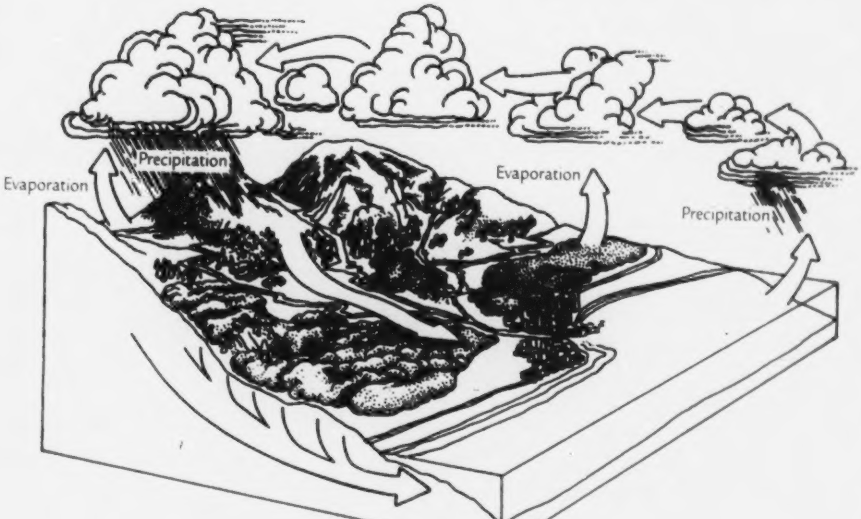
2.What are the pros and cons of using pesticides and herbicides in agriculture?

a. How are pesticides and herbicides applied to crops?

b. Do specific methods have a greater or lesser potential impact on runoff?

c. What regulations govern a farmer's ability to use pesticides and herbicides?

3.How do urban areas control surface water runoff?



Modeling the Processes of Chemical Transport

The purpose of this activity is to demonstrate the process by which chemicals move through air and water, and the relative rates at which they move.

PROBLEM

How fast can chemicals move through air and water?

MATERIALS

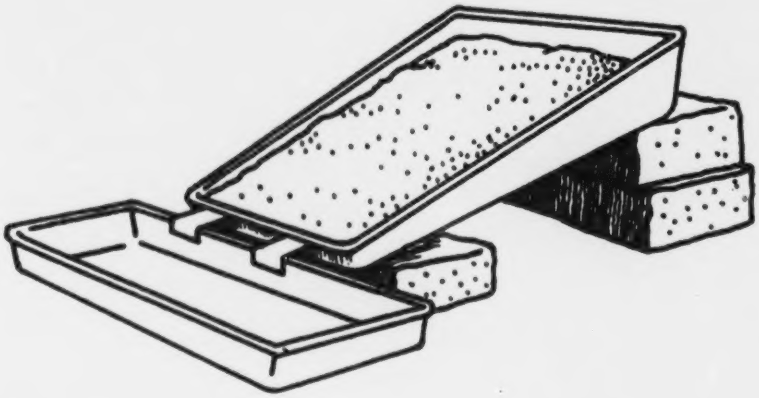
Fragrance or fruit extract
Measuring tape
Fan
50 ml buret
Food coloring
Stream tables
Three soil mixes: rocks and sand, loam, silt and clay

PROCEDURE: AIR TRANSPORT

1. To model the movement of a chemical through air, place a volatile chemical with a distinctive smell, such as a perfume or a fruit extract, on a table top at one end of the room.

2. Record the amount of time necessary for the chemical to diffuse throughout the room. Measure the distance from the starting point. Calculate the average rate of transport.

3. Use a fan to demonstrate the effect of winds. Point the fan in different directions and make comparisons.



PROCEDURE: WATER TRANSPORT

1. To model the transport of a chemical through a liquid medium, set up a 50 ml buret in a holder on a stand. Fill the buret with water and adjust the water to the zero mark. Measure 25 cm down from the top level of the water and place a mark on the buret with a grease pencil.

2. Add 3 drops of food coloring with a Pasteur pipet to the surface of the water. Begin timing when the first drop hits the water.

3. Record the amount of time before the color is visible at the 25 cm mark.

4. Repeat for three trials. Calculate the average rate of transport of the food coloring through the water.

PROCEDURE: GROUNDWATER TRANSPORT

1. To model the transport of a chemical through the ground by groundwater, fill three stream tables with soil mixes. One table should have a mixture of rocks and sand, one table should have a loam mix, and one table should have a silt and clay mix. Place the stream table so the end with the drain is several inches lower than the other end. Make a trench in the soil on the upper end.

2. Saturate the soil in each tray with clear water.

3. Fill a gallon jug with water and add enough food coloring so the water has a distinct color. Slowly pour the colored water into the trench. Begin timing when the colored water first touches the soil.

4. Continue adding colored water slowly, so the water is passing through the soil rather than running off on the surface.

5. Continue timing until the first of the colored water is seen at the drain. Repeat for each of the soils.

6. Calculate the average rate at which the color is transported through the soil.

STUDENT DATA SHEET: Modeling Transportation

AIR TRANSPORT

	TRIAL 1	TRIAL 2	TRAIL 3	AVERAGE
Time				
Distance				
Rate of Transport				

QUESTIONS

1. Make a general statement about the rate at which chemicals are transported through the air, and why this might be so.

2. How does the size of the airshed affect the dispersion time of an airborne chemical?

WATER TRANSPORT

	TRIAL 1	TRIAL 2	TRAIL 3	AVERAGE
Time				
Distance				
Rate of Transport				

QUESTIONS

1. Make a general statement about the rate at which chemicals are transported through the water, and the factors which affect it.

2. How does the size of the watershed affect the dispersion time of a waterborne chemical?

3. How does the location of a chemical released in water affect its impact?

GROUNDWATER TRANSPORT

	TRIAL 1	TRIAL 2	TRAIL 3	AVERAGE
Time				
Distance				
Rate of Transport				

QUESTIONS

1. Make a general statement about the rate at which chemicals are transported through the ground.

2. Why is groundwater important to the leeching of chemicals through soil?

3. How does the location of a groundwater chemical release affect its impact?

Rate of Transport

ACTIVITY 4.2

Before conducting this activity, you may wish to first use *Database Basics* Activity 3 to introduce surveying and extrapolation methods, or *Database Basics* Activity 7 to teach students to make predictions based on data.

This activity requires the use of TRI search instructions from Activity 2.1 (page 4).

ANSWERS

1. The most soluble chemical will be transported the fastest.

2. The least soluble chemical will be transported the slowest.

3. Chemicals which are not transported and do not degrade will most likely accumulate.

4. An increase or decrease in the amount of water will affect the concentration of chemicals in the water—more water means a lesser concentration, thus a smaller amount of chemical will be measured. A change in the rate of movement of the water will also change the amount of chemicals transported, and therefore the amount present.

Rate of Transport

In this activity, you will use TRI data to study how chemicals may flow through a local stream or river. If you identified a local watershed in Activity 1, then use the map you have developed. If not, use a map of a local river or stream.

PROCEDURE

1. Using the TRI database, do a search for the name of a waterway—stream, river, or lake—you have chosen to investigate.
2. If the set has more than 40 records, use the geographical search tools—state, county, etc.—to reduce the set to fewer than 40 entries. Select the chemicals that have the most releases over the four-year period. Select a total of 12 releases from a minimum of three locations.
3. Locate the position of each of the releases and mark it on the map. You may use addresses, or latitude and longitude coordinates. Develop a key that will allow you to identify the facility and chemical released.
4. Use the Chemical Substance Fact Sheets to determine if the chemical is soluble in water, or likely to precipitate into the sediments. Use this information to rank your chemicals by how quickly they will be transported.
5. Choose three locations downstream of the release sites and mark them on your map.
6. For each of the locations, predict which chemicals might be found there in measurable quantities.

STUDENT DATA SHEET: Chemical Transportation

Releases into (stream name) ______________________________.

RELEASE NUMBER	CHEMICAL NAME	FACILITY NAME	LATITUDE	LONGITUDE
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				

DOWNSTREAM LOCATIONS

CHEMICAL NAME	LOCATION 1	LOCATION 2	LOCATION 3

QUESTIONS

1. Which chemical do you think will be transported the fastest? Why?

2. Which chemical will be transported the slowest? Why?

3. Which chemical is most likely to accumulate in sediment from year to year?

4. How will events such as rainstorms or droughts affect the amounts or concentrations of the chemicals in a waterway?

Solubility of Oxygen

This activity requires the collection of several environmental samples. You can collect these samples yourself, or you can involve students in the collection process.

Collect water samples from at least three different sites, or three different points along the same waterway. Water can be collected in narrow-mouthed bottles, which should be completely filled and sealed to prevent the entrapment of atmospheric oxygen. The samples should be fixed to prevent further physical mixing or biological action. Biological action may be halted by fixing the sample with 1 ml of concentrated H_2SO_4 and 1 ml of 2% sodium azide (NaN_3) solution.

In addition to these three samples, collect enough stream or pond water for 500 ml samples for each student group.

Students should provide their own 500 ml, wide-mouth sealable glass jars.

ANSWERS

1. Heating provides energy for the gas to leave the solution.

2. Decomposers can grow and reproduce extremely rapidly, especially when there is a large supply of food. Decomposers will outcompete fish by outnumbering them, and using up available resources faster.

3. A polluted aquatic ecosystem will have lower levels of dissolved oxygen. Because catfish can tolerate lower levels of dissolved oxygen than trout or bass, they can be used as an indicator of pollution. More catfish indicate a less pure body of water; one that has many bass and trout is probably more pure.

4. Thermal pollution can have great impacts on the ecosystem. A major impact would be the dramatic decrease in the oxygen available in the area.

EXTENSION

1. Have your students research the area from where you collected the environmental samples in the TRI database. Can they connect the release of toxics in the area to the number of decomposers or different types of fish, and therefore to high or low levels of DO in the water?

ACTIVITY 4.3

You may wish to first conduct *Database Basics* Activity 4 to introduce the concepts of parts per million, detection, and indicators. Additionally, *Database Basics* Activities 5 and 6 can give students some basic mathematical tools for comparing and describing the measurements they take.

Solubility of Oxygen

The amount of oxygen dissolved in the water of an ecosystem is often an excellent indicator of the health of the ecosystem. Decomposers use dissolved oxygen to break down many pollutants, especially organic compounds present in sewage. A large amount of these pollutants may cause populations of decomposers to increase rapidly. However, high pollution levels may result in fewer complex organisms—such as fish—because the oxygen that they also need is used by decomposers. Oxygen solubility is also temperature dependent. As temperatures rise, the amount of oxygen that can be dissolved in the water decreases. A large influx of sewage during warm, summer months may cause a body of water to turn anoxic—lacking oxygen—and cause a fish kill.

The level of dissolved oxygen (DO) is an empirical indicator of water quality. Another indicator is the basic oxygen demand (BOD), which is measured in the same way as DO. The BOD is the amount of oxygen used by the microorganisms to break down pollutants. In a BOD measurement, the change in the amount of oxygen is measured over a set period of time. For a five-day test, a BOD of 1 ppm represents pure water, a BOD of 3 ppm fairly pure, and a BOD of 5 ppm is approaching impure. Untreated municipal sewage may have BOD values from 100 to 500 ppm.

METHOD OF MEASURING O_2

In the classroom, or in the field, there are two basic choices for measuring dissolved oxygen:

1. Dissolved Oxygen Meter or Probeware
2. Chemical Test Kits

A dissolved oxygen meter, or probeware, is the most flexible and portable tool to use, especially if multiple measurements are to be taken. It is, however, the most expensive method of measuring dissolved oxygen, unless it is used frequently. Several companies make either stand alone-meters or probes that are used with a variety of data collecting systems, including Vernier's Serial Box Interface, Texas Instruments CBL, Quantum Technology's LEAP system, and Logal's Explorer system.

Many companies sell chemical test kits that determine dissolved oxygen content. The kits have the advantage of being extremely easy to use and dispose of, and they cost about 50 cents per test. The best known water testing company, Lamotte, uses a modified Winkler Azide reaction in its test kit.

Solubility of Oxygen

PROBLEM

What is the effect of temperature on dissolved oxygen?

MATERIALS

Environmental sample
Thermometer
Hot plate with magnetic stirrer
Sealable glass jar
Compost
DO measurement equipment

PROCEDURE

1. Prepare your sample by slowly heating it up on a hot plate. Constantly stir with a magnetic stirrer. (Stirring will ensure the water is saturated for that temperature.) Place a thermometer in the sample.

2. Measure the amount of dissolved oxygen at 8-10°C, 15-18°C, 22-24°C, and 28-30°C.

3. Record the amounts of DO, in parts per million.

PROBLEM

What is the DO level in an environmental sample?

PROCEDURE

1. Record the temperature of each environmental sample.

2. Measure the DO level of each sample, and record your results.

PROBLEM

What is the BOD of an environmental sample?

PROCEDURE

1. Measure the amount of DO of the stream or pond water sample, and record your results.

2. Place a layer of compost at the bottom of a 500 ml, wide-mouth bottle. Fill the bottle completely with the collected water and seal with the top.

3. Place the bottle on an inside window ledge and let stand for five days.

4. After five days, open the bottle slowly, so as not to disturb the surface, and quickly measure the DO. Record your results.

5. Calculate the BOD.

STUDENT DATA SHEET: Dissolved Oxygen

EFFECTS OF TEMPERATURE ON DISSOLVED OXYGEN

TEMPERATURE (°C)	8–10	15–18	22–24	28–30
Dissolved Oxygen (ppm)				

DISSOLVED OXYGEN IN ENVIRONMENTAL SAMPLES

SAMPLE NUMBER	1	2	3
Sample Temperature (°C)			
Dissolved Oxygen (ppm)			

BASIC OXYGEN DEMAND

Temperature of sample before ______________________________

Amount of DO before ______________________________

Temperature of sample after ______________________________

Amount of DO after ______________________________

BOD ______________________________

QUESTIONS

1. Most solids increase in solubility as temperature increases. Suggest a reason why oxygen and other gases decrease in solubility as temperature increases.

2. In the competition for oxygen, suggest a reason why fast growing decomposers may outcompete fish.

3. In a freshwater ecosystem, trout require the most dissolved oxygen, followed by bass. Catfish require the least dissolved oxygen. How can this be used to determine the purity of a body of water?

4. A factory uses water as a coolant. The water it returns to the stream is pure, but 30°C warmer. Explain why this is considered a form of pollution.

ACCUMULATION & BREAKDOWN

Each year the spring rains bring millions of liters of water into the Chesapeake Bay. With this water comes millions of metric tons of sediments, the soils and the chemicals that have washed off of the land in the Chesapeake's watershed. As fresh water pushes its way down the bay, it is met by salt water from the ocean. The mixing of these two types of water in an enclosed body is what makes the Chesapeake an estuary. This meeting point is a prime location for the accumulation of toxic chemicals.

The mixing of the salt water with the fresh water causes a change in the water's density. The denser water slows down, which causes it to drop the sediments it is carrying. This occurs at a location referred to as the turbidity maximum. It is the area where the light penetrates the water the least because of the suspended sediments. Just below the turbidity maximum is the zone where most of the sediments are deposited, and all of the chemicals tied up with those sediments are deposited in this zone. The pollution history of a region can be read by drawing a core sample (a long, narrow, cross-section of the sediment) in any major waterway, and analyzing the sediments for toxic chemicals. The chemical accumulation in the layer of sediments reflects the amount of the chemical in the environment when that layer of sediment was deposited.

In addition to naturally occurring accumulation, humans have caused the accumulation of chemicals in ecosystems by repeated releases at a point source. At these locations, the levels of these chemicals may far exceed the surrounding areas. Examples of this artificial accumulation include the burial of toxic wastes in landfills, storage lagoons for polluted waste, and the discharge of septic systems and industrial wastewater treatment plants.

SECTION 5 GOALS

5.1

FOCUS

Chemicals that enter the environment are not static. Some chemicals become concentrated over time, while other chemicals break down and "disappear" from the ecosystem. The amount of a chemical present in the environment at any time is a combination of these variables. How do scientists track the amounts of chemicals in the environment? How can they predict the changes that may occur?

OBJECTIVE

To estimate the amount of a toxic chemical in an ecosystem by using its persistence (half-life) and bioaccumulation data from the TRI Chemical Substance Facts Sheets, and the release data for a waterway.

5.2

FOCUS

Many people enjoy eating oysters. However, oysters are filter feeders, which may ingest and store large amounts of toxic chemicals that are released into waterways. How clean does a waterway have to be in order for humans to safely consume oysters?

OBJECTIVE

To demonstrate the accumulation of toxic compounds in a food chain.

5.3

FOCUS

It is common to consider how chemicals affect living organisms. But how do living things affect the chemicals in their environment?

OBJECTIVE

To demonstrate and measure the chemical changes caused by a living organism.

ACCUMULATION

Regardless of how chemicals enter the ecosystem, they may be there for a long time. In the 1960s, scientists noticed that some birds of prey, such as ospreys and eagles near the Long Island Sound, were dying in alarming numbers. Females were laying eggs with extremely weak shells, which led to a high chick mortality rate and a drop in the species' population. Analyses revealed extremely high concentrations of dichloro-diphenyl-trichloro-ethane (DDT), a pesticide used during the 1950s to clear the beaches of mosquitoes, in the birds' bodies and eggs. Analyses of the environment, especially the water of the estuary, however, revealed low concentrations of DDT. Scientists posed the question: How were the birds absorbing enough DDT to harm themselves when the levels all around them were so low?

The answer lies in the concept of bioaccumulation. DDT is far more soluble in lipids (fats) than it is in water. The DDT that was being applied on the beaches was running off the land into the estuary, and being absorbed in the fatty membranes of aquatic microorganisms, such as algae and bacteria. Small fish ate the algae, and DDT accumulated in the fatty tissue of their bodies. The small fish were eaten by larger fish, who also accumulated the DDT. They, in turn, were eaten by the ospreys and eagles, resulting in the further concentration of DDT in their tissues. When the bioaccumulated concentrations reached toxic levels, the bird population was drastically impacted.

Not all chemicals are accumulated in the same form in which they are released into the environment. Once chemicals are introduced into the environment, the breakdown process begins. Chemicals may be broken down into simpler compounds by many processes. Ultraviolet light, heat, and microorganisms all break down toxic chemicals into smaller, less harmful substances. Chemicals with very different lifetimes have been designed for use in industry. Polychlorinated biphenyls (PCB), for example, were used extensively during World War II to manufacture electric equipment such as transformers. PCBs were effective for industry use because they do not readily break down. However, PCB use was banned when it was discovered that they persist and accumulate in the environment. Many of the toxic chemicals that are persistent—resist breakdown—may be bioaccumulated.

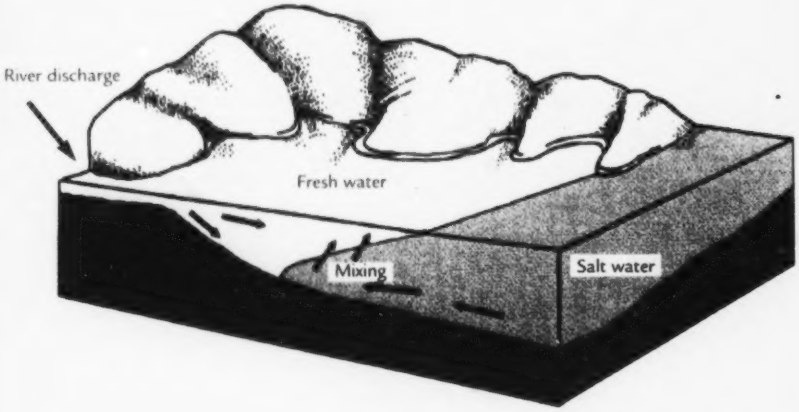
Today, many chemicals are designed to have very short lifetimes—to do their job then break down. Dimilin, for example, is a pesticide used to combat gypsy moths. It controls the reproduction of the moths by inhibiting their ability to produce chitin, which forms their exoskeleton. However, many other aquatic organisms, such as crabs and shrimp, also rely on chitin exoskeletons. If the Dimilin were to be transported from the moths' ecosystem to the crabs' ecosystem, the result could be disastrous. In order to prevent this, Dimilin is made to be thermally unstable. Extended exposure to moderate heat causes it to break down into two less harmful substances.

BREAKDOWN

In 1989, a major environmental disaster occurred when the Exxon *Valdez* spilled thousands of gallons of oil into Alaska's Prince William Sound, an estuary that covers about 8,800 km^2 and provides habitat for huge numbers of birds and marine species. The spill impacted all the organisms that lived in that ecosystem. Many ideas were presented on how to clean up the spill but bioremediation was decided upon in the end. Bioremediation is the process of using living organisms, such as bacteria, to clean environments that have become chemically polluted. It is made possible by the existence of living organisms that can make changes in their chemical environment. Some bacteria use a wide variety of chemicals as part of their natural energy pathways. Therefore, if a bacteria will use pollutants as energy sources, they can be used to break these pollutants down to less harmful compounds.

When this process occurs naturally, it is called biodegradation. When man purposely introduces an organism to an environment for the purpose of removing pollutants, it is called bioremediation. An important decision is always involved when scientists decide to introduce new organisms to an environment. However, many of the bacteria used for bioremediation have a special attribute that makes this particular kind of decision a little easier: these organisms are highly selective. When the pollutant is completely removed from the environment, the bacteria lose their source of food and die, thereby posing no threat to the whole ecosystem.

A Typical Salt-Wedge Estuary



Half-life and Bioaccumulation

ACTIVITY 5.1

You may want to introduce students to basic search concepts before beginning this activity. One way to do this might be to distribute copies of Introduction to Data and Databases on pages iv to vi of *Database Basics*. You might also discuss concepts such as toxicity during or before this activity; *Database Basics* Activity 4 presents a procedure for teaching about toxicity. And because students will be working with very big and very small numbers in this exercise, you might wish to first conduct *Database Basics* Activities 4 or 5.

You may want to print out the Chemical Substance Fact Sheets for the chemicals prior to class, in order to have more time for discussing accumulation and half-life.

ANSWERS:

Barium Nitrate	P
Arsenic Pentoxide	P
Styrene Monomer	N
Mercuric Nitrate	P
1,4 Dichlorobenzene	N
Beryllium Oxide	P
Ethylene Dibromide	S
Manganese Dioxide	P
Molybdenum Trioxide	P
Ethylene Glycol	S
Vinyl Acetate	S
Maleic Anhydride	N
Diocofol	S
4-Nitrophenol	S
Antimony Trichloride	P
Zinc Potassium Chromate	P
2,4 Dimethylphenol	S
Chromic Sulfate	P
1,2-Butylene Oxide	S
Lead Dioxide	P
1,3-Butadiene	N
Zinc Oxide	P
Asbestos	P
Chromium Nitrate	P
Toluene	N
Anthracene	S
Hydrazine Sulfate	S,P
Ethyl Benzene	N
Benzyl Chloride	S
Chromic Acetate	P
Manganese Nitrate	P
Chromium (III) Oxide	P
Mercuric Subsulfate	P
Allyl Chloride	N
Lead Sulfide	P
Aluminum Oxide	P
Mercurous Oxide	P
Propoxur	S
p-Cresidine	S

SAMPLE ANSWERS

1. Zinc Potassium Chromate
2. a. Discharge from galvanizing plants.
   b. Death in animals, death and low growth rates in plants.
   c. High chronic toxicity to aquatic life, shortened life spans, lower fertility.
   d. Yes. The level of zinc in fish may be considerably higher than concentrations in the water.
   e. 11103-56-9

Half-life and Bioaccumulation

The purpose of this activity is to estimate the amount of a toxic chemical in an ecosystem by determining its persistence, half-life, and bioaccumulation using TRI's Chemical Substance Fact Sheets and the release data for a waterway.

PROCEDURE

1. Locate the TRI Chemical Substance Fact Sheets for each of the chemicals. Mark each as either persistent (half life greater than 200 days), moderately persistent (half-life 20 to 200 days), slightly persistent (half-life 2 to 20 days), or non-persistant (half-life less than two days).

2. Return to the TRI releases database. From the **Select** menu, choose **CASRN** and enter the CAS number of the persistent chemical you selected. From the **Options** menu set the **Search Set** to **Last Set Created**. From the **Select** menu choose **Sum Water Releases** and enter the low value of 100 and the upper value of 1000. Display the results by the facility name. Choose a facility that has a release for three consecutive years. Enter the information on the Student Data Report sheet.

HALF-LIFE

Highly persistent chemicals have a half-life of greater than 200 days. This means it takes at least 200 days to reduce the chemical to one half of its original amount. For the purpose of this book, use a half-life to exactly 200 days to estimate the maximum amount of the chemical remaining if the chemical was released on the first day of each year. The chemical released during the first year will degrade through 5.5 half-lives (365 days x 3 years/ 200 days) before the end of the third year. The chemical released during the second year will degrade through 3.7 half-lives (365 days x 2 years/ 200 days). The chemical released the final year will only have 1.8 half-lives (365 days/ 200 days) to degrade. The total amount remaining after three years can be found by calculating the sum:

Total Remaining = (Amount Released Year 1)$(1/2)^{5.5}$
(Amount Released Year 2)$(1/2)^{3.7}$
(Amount Released Year 3)$(1/2)^{1.8}$

FOR EXAMPLE:

Calculating the accumulation and breakdown of asbestos released by Vermont Asbestos Group Inc., from 1991 to 1993:

Year of Release	**1991**	**1992**	**1993**
Amount of Release	**250 lbs**	**250 lbs**	**250 lbs**

Total remaining at the end of 1993 = (250 lbs)$(1/2)^{5.5}$
(250 lbs)$(1/2)^{3.7}$
(250 lbs)$(1/2)^{1.8}$
= 5.5 lbs +
19.2 lbs +
71.8 lbs
= 96.5 lbs of asbestos

STUDENT DATA REPORT: Accumulation and Breakdown

Barium Nitrate
Arsenic Pentoxide
Styrene Monomer
Mercuric Nitrate
1,4 Dichlorobenzene
Beryllium Oxide
Ethylene Dibromide
Manganese Dioxide
Molybdenum Trioxide
Ethylene Glycol
Vinyl Acetate
Maleic Anhydride
Diocofol
4-Nitrophenol
Antimony Trichloride
Zinc Potassium Chromate
2,4 Dimethylphenol
Chromic Sulfate
1,2-Butylene Oxide
Lead Dioxide
1,3-Butadiene
Zinc Oxide
Asbestos
Chromium Nitrate
Toluene
Anthracene
Hydrazine Sulfate
Ethyl Benzene
Benzyl Chloride
Chromic Acetate
Manganese Nitrate
Chromium (III) Oxide
Mercuric Subsulfate
Allyl Chloride
Lead Sulfide
Aluminum Oxide
Mercurous Oxide
Propoxur
p-Cresidine

1. Select one of the highly persistent chemicals listed.
2. Locate its Chemical Substance Fact Sheet. Answer the following questions:
   a. How does this chemical enter the environment?
   b. What are its acute, or short term, ecological effects?
   c. What are its chronic, or long term, ecological effects?
   d. Is this chemical subject to bioaccumulation?
   e. What is the CAS number of this chemical?
3. Calculating the accumulation and breakdown of

_______________ released by _______________ during _______________.
(chemical name) (facility name) (reporting years)

Year of Release			
Amount of Release			

The Bioaccumulation Game

The purpose of this activity is to demonstrate the accumulation of toxic compounds in a food chain. This activity is best explained verbally, and has no Student Section. Provide the reading on bioaccumulation (page 42) prior to class, and ensure that students understand the concept before you begin.

MATERIALS

300 colored beads or jelly beans
100 Paper cups

PROCEDURE

1. Prepare markers, such as colored beads or jelly beans, to represent food units—choose one specific color to represent toxics in the food chain. Students should not know which color represents the toxics. Distribute one score sheet (at right) to each student which designates them as a first-level consumer or a top-level consumer. There should be one top-level consumer for every five first-level consumers.

2. Place three beads or beans each in 100 paper cups before class. Not all cups need to have a toxics bead or bean, but no cup should have more than one.

3. Have each first-level consumer take one cup and tally each color they have. The first-level consumers should continue "eating" and tallying colors until all of the cups are used up. After the cups are gone, have each top-level consumer select five first-level consumers, and "consume" them by summing their tally sheets.

4. When the top-level consumers are done tallying their colors, announce the toxics color. All first-level consumers who have five beads/beans of that color would have died by toxic poisoning, had they not been eaten. Top-level consumers who have accumulated 10 markers through their consumption of first-level consumers have been killed by bioaccumulation of toxics.

5. Repeat steps two through four until all top consumers are dead. First-level consumers begin each round in perfect health. Top-level consumers must carry over their number of toxics from the previous round. You may change the color of the toxics bead or bean after each round, but continue to place no more than one of that color in each cup.

EXTENSION

1. Have students research species that have been endangered by the accumulation of toxic compounds.
   a. What was the source of the toxic chemical?
   b. How did it enter the species' ecosystem?
   c. How did it get into the species?
   d. How did it affect the species?
   e. How was the issue addressed, and what has happened to the species?

ACTIVITY 5.2

Prior to beginning this activity, you might wish to teach students about toxicity using *Database Basics* Activity 4. Additionally, *Database Basics* Activity 5 might be used to review the concepts of mass, weight, and size.

SCORE SHEET FOR FIRST-LEVEL CONSUMERS

ROUND NUMBER	NUMBER OF COLOR 1	NUMBER OF COLOR 2	NUMBER OF COLOR 3
1			
2			
3			
4			

SCORE SHEET FOR TOP-LEVEL CONSUMERS

ROUND NUMBER	NUMBER OF COLOR 1	NUMBER OF COLOR 2	NUMBER OF COLOR 3
1			
2			
3			
4			

Chemical Changes by Living Organisms

ACTIVITY 5.3

You might wish to conduct *Database Basics* Activities 7 and 9 to prepare students to graph data and display their findings.

Bacillus subtilis, a bacteria, can easily be grown at slightly above room temperature, and cultured in a liquid medium. *Bacillus subtilis* is a fermenter that produces acetic acid from dextrose. The amount of acid provides the information about the rate of sugar degradation in the medium.

Unlike most microbiological procedures, this activity does not require extensive materials, special equipment, or aseptic techniques. *Bacillus subtilis* is legal for classroom use. It is not an animal or plant pathogen, and is available from Carolina Biological in a slant tube or on a plate.

The medium used to grow the *Bacillus subtilis* is a phenol red broth with dextrose. This medium is available from Carolina Biological as Phenol Red Broth Base and Dextrose or premixed as Phenol Red Dextrose Broth. The premixed medium is not preferred for this activity because the initial amount of dextrose can not be investigated as a variable.

The pH can be monitored with universal pH indicator strips, a pH meter with a pH probe (calomel electrode), or with a recording pH system such as Vernier's Serial Box Interface and Data Logger Program.

Assign each group an amount of dextrose to add to their mediums, so that they may compare their data. An appropriate range for the amount of dextrose is 0.5 g/L to 5.0 g/L.

You will also need Benedict's solution for this activity.

ANSWERS

1. A control can be made with no organism to show the dextrose does not break down spontaneously.
2. The faster the pH changes, the faster the organisms are growing and using the glucose.
3. The rate of growth changes.
4. Yes, a compound is changed by a living organism.
5. By making a direct comparison.

EXTENSION

1. Have students give an example of a living organism used for bioremediation, and describe one event in which it was used.

Chemical Changes by Living Organisms

In this activity, you will measure the amount of a nutrient in a medium, monitor an organism as a population grows to the limits of its food supply, and measure the amount of a waste product.

MATERIALS

Phenol Red Broth
Distilled water
2 L beaker
Dextrose solution
Benedict's solution
Hot plate
Magnetic stirrer

PROCEDURE

1. Create a medium by adding 5 g of the Phenol Red Broth Base to 1.0 L of distilled water in a beaker. Heat and stir on a hot plate until the solution is homogeneous. The solution should be a clear red color.

2. Continue to heat for several minutes, until the solution is just about to boil.

3. You will be assigned an amount of dextrose to add to the medium.

4. Demonstrate the presence of the dextrose in the medium by adding Benedict's solution to a small amount of the medium in a separate test tube. These samples of the medium with a known concentration of dextrose can be retained for comparison with the results of the Benedict's test after the organism has grown.

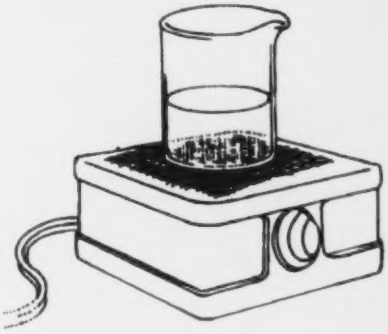
5. Transfer a small amount of the organism into the prepared medium by using a spatula or pipet.

6. Mix the medium with a magnetic stirrer. Heat to a temperature of 25-30°C, then allow to stand at room temperature. The culture may take 24 to 72 hours to completely use all of the available nutrients.

7. Sample and record the pH on a regular basis for the duration of the experiment. (The Phenol Red in the medium will turn yellow as the amount of acid increases.)

8. After the culture has crashed—mostly died—another sample can be drawn and tested with the Benedict's solution for the presence of dextrose.

9. Graph your data.



STUDENT DATA REPORT: Chemical Changes by Organisms

Initial concentration of dextrose ______________________

TIME vs. pH

TIME	pH	TIME	pH

Final concentration of dextrose ______________________

QUESTIONS

1. How can we determine the organism is responsible for the change to the dextrose?

2. How does the pH show the rate of growth of the organisms?

3. What does graphing pH versus time reveal about the process?

4. Is this a good model of biodegradation?

5. How can a series of known concentration solutions be used with the Benedict's solution to quantify the amount of dextrose in an unknown solution?

TOXICITY

SECTION 6 GOALS

6.1

FOCUS

We are repeatedly warned that certain chemicals can harm our health, but it is nearly impossible to completely avoid harmful chemicals. How do we know how much we can tolerate without risking our health?

OBJECTIVE

To describe and measure the toxic effects of chemicals on humans and other organisms.

6.2

FOCUS

We breathe constantly because we need oxygen. However, the air we take into our bodies is a complex mixture. How do we know if we are at risk from chemical pollution of the air?

OBJECTIVE

To use information found on Chemical Substance Fact Sheets to make a risk assessment.

6.3

FOCUS

A local waterway has experienced a fish kill. Hundreds of fish of all sizes are dead. How can you determine what has caused it?

OBJECTIVE

To determine the toxic levels of chemicals in an aquatic environment.

A chemical is considered toxic if it affects adversely the health and growth of an organism. Defining chemicals as toxic is a slippery business, because each organism reacts differently to each chemical, or combination of chemicals, in its environment. Different amounts of the same chemical may cause different reactions in the same organism. The result of exposure to a toxic chemical may be varied, and may include reactions such as avoidance, irritation, sterility, or death.

The Union Carbide factory in Bhopal, India produced pesticides, which were intended to increase the amount of food harvested in India by limiting insect damage. In 1984, an industrial accident caused the release of methyl isocyanate, a deadly gas. This release killed thousands of people.

Similar events happen every day, when organisms find themselves poisoned in the only environment in which they can live. Toxicologists tabulate the effects of chemicals by measuring LD_{50} values—the concentration, or lethal dose, of a chemical that causes death in half of the organisms tested. A species may have several LD_{50} values for the same chemical, because larval and juvenile forms may have different tolerances than adults.

Permissible exposures for humans are established by government agencies such as the Occupational Safety and Health Administration (OSHA). For example, the permissible exposure limit (PEL) for methyl isocyanate has been set at 0.02 ppm over an eight hour period. No person should be exposed to a greater level of this chemical without follow-up medical care. The acute (short-term) health affects occur shortly after exposure, including severe irritation of the lungs and possible pulmonary edema, a build-up of fluid in the lungs. The chronic (long-term) effects of repeated exposure may include permanent lung damage.

Toxic Effects on Organisms

The toxicity of various chemicals to algae and aquatic invertebrates, can easily be tested using a simple setup built from aquarium supplies. Each setup will allow for the testing of one replicate consisting of a control and four test trials. Replicates should be duplicated by different groups within a class to provide a sufficient amount of data. To be statistically significant, each control and test trial should consist of a minimum of 30 organisms. A setup consists of five 600 ml beakers, an aquarium pump, an aquarium gang valve, tubing, and five airstones or bubblers.

This activity requires the collection of pond water from just below the surface; avoid floating debris or mats of algae. You can collect these samples yourself, or you can involve students in the collection process.

You will also need to obtain a commercial liquid herbicide; weed killer will suffice. If students have trouble starting the naturally occurring algae, a commercially obtained freshwater culture may be added in equal amounts to each of the beakers.

Answers will vary.

EXTENSIONS

1. Ask students how easy or difficult they think it is to be exposed to toxic chemicals in their own environments, like their home or school. Have students make a list of all the toxic chemical substances they can find in their homes—not including foods or food-related products. In the following class, have students discuss their lists. Did they identify similar products? Do they agree with the identification of each chemical? Distribute copies of the Chemicals in the Household list (Appendix A, page 69), and ask students to compare their lists to it. Did they identify many of the chemicals on the list? Why do they think they overlooked the ones they did not identify?

2. Ask students to choose one chemical on the Chemicals in the Household list, and locate its Chemical Substance Fact Sheet. Have them write a brief report about that chemical. For example: what are the health effects related to the chemical; what household product(s) is it found in; what is it used for; where was it located in their house; how should it be disposed of; how long does it persist in the environment?

ACTIVITY 6.1

Prior to beginning this activity, you might wish to teach students about toxicity and concentration using *Database Basics* Activity 4. You might also wish to have students conduct *Database Basics* Activities 7 and 9 to prepare them to graph and display their findings.

Toxic Effects on Organisms

In this activity, you will test the toxicity of herbicides to algae found in pond water.

PROBLEM

What is the toxic level of a herbicide to naturally occurring algae in pond water?

MATERIALS

Pond water
Aquarium pump and air stone
Five 1 L beakers
Herbicide

PROCEDURE

1. Set up five beakers in natural sunlight, or under a grow light. Place an airstone connected to an aquarium pump, via the valve, in each of the five beakers.

3. Label each of the beakers as Control, Test Trial 1, Test Trial 2, Test Trial 3, and Test Trial 4.

4. Measure 500 ml of unfiltered pond water into each of the beakers. Adjust the airpump valves to produce a slow bubbling.

5. Using a micropipet, add 200 µl of the herbicide to Test Trial 1, 600 µl of the herbicide to Test Trial 2, 1200 µl of the herbicide to Test Trial 3, and 1500 µl of the herbicide to Test Trial 4.

6. Allow the algae to grow in the light. Each day record the growth as very strong, strong, weak, or no growth. Monitor the growth until the controls have reached the maximum growth sustainable.

STUDENT DATA SHEET: Aquatic Toxicity

ALGAE AND HERBICIDES

	DAY 1	DAY 2	DAY 3	DAY 4
Control				
Test Trial 1				
Test Trial 2				
Test Trial 3				
Test Trial 4				

SUMMARY OF CLASS DATA

	REPLICATE NUMBER	1	2	3	4
Maximum Amount of Herbicide Allowing Growth					

QUESTIONS

1. During which day was the density of the algae in control the greatest?

2. In which of the test trials was the growth inhibited by the presence of the herbicide?

3. Interpolate the maximum amount of herbicide tolerable for growth from your four trials.

4. Determine the class average for the maximum amount of herbicide tolerable for growth.

Risk Analysis of Air Releases

The purpose of this activity is to allow the student to use the TRI Chemical Substance Fact Sheets to determine the toxicity of common chemicals and to do a risk analysis for humans and other organisms.

EXTENSION

1. As a class, contact the facility responsible for the release. Have students find out about the safety precautions used by the facility. What would the facility do in the event of an accidental release?

Risk Analysis of Air Releases

In this activity, you will use the TRI database to identify a chemical that is released into the air from a facility near your home, and determine what risks might be posed by this chemical.

PROCEDURE

1. Use the TRI database to locate the facility nearest to your home that has a significant air release of a chemical. Locate the TRI Chemical Substance Fact Sheet for that chemical and answer the questions on the Student Data Report.

STUDENT DATA REPORT: Toxic Air Releases

1. What is the name of the chemical released?

2. How much was released?

3. What is the name of the facility that released the chemical?

4. Estimate the distance, by air, from the facility to your home or school.

5. Summarize the hazards of exposure to the chemical.

6. What is the PEL for the chemical?

7. Estimate the amount of chemical which would need to be released at the facility in order to exceed the PEL at your home or school. (Hint: Use a map to estimate the volume of the hemisphere that has the facility at the center and your house on the edge.)

8. Are you at risk if an air release of this chemical occurs? How much release can occur before you are at risk?

9. How soluble is the chemical in water?

10. How is the chemical distributed in the environment?

11. What other organisms may be at risk from a release of this chemical? Why?

Chemical Toxicity in an Aquatic Environment

This activity requires the collection of pond water from just below the surface; avoid floating debris or mats of algae. You can collect these samples yourself, or you can involve students in the collection process.

Be sure to dispose of lead nitrate properly.

ANSWERS

1. Answers will depend on individual data.
2. Answers will vary. (About 0.05 mg/m^3).
3. In solutions or compounds that humans ingest or inhale.
4. Leaded gasoline and lead-based paints.

EXTENSIONS

1. Have students research the "Sick Building" syndrome. Have modern building techniques addressed this problem?

Chemical Toxicity in an Aquatic Environment

MATERIALS

5 L of pond water
Aquarium pump and air stone
Five 1 L beakers
Pipet
Daphnia magna

PROBLEM

What is the LD_{50} for Lead (II) ion on *Daphnia magna*, a freshwater, column-dwelling invertebrate?

PROCEDURE

1. Set up five 1 L beakers. Place an air-stone connected to an aquarium pump via the valve in each of the 5 beakers.

2. Label the beakers as Control, Test Trial 1, Test Trial 2, Test Trial 3, and Test Trial 4.

3. Measure 500 ml of unfiltered pond water into each of the beakers. Adjust the valves to produce a slow bubbling.

4. Use a pipet to place 10 *Daphnia* in each of the beakers.

5. Make a stock solution that is 0.1 g/L of Lead (II) by dissolving 0.16 g of $Pb(NO_3)_2$ in 1 L of distilled water.

6. Add 5 ml of the stock solution to Test Trial 1 to make an exposure concentration of 1,000 ppm.

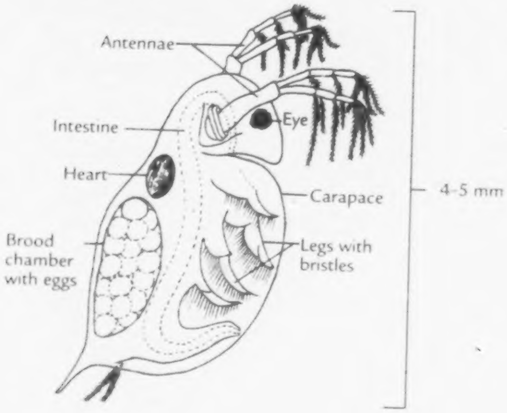
7. Add 2.5 ml of the stock solution to Test Trial 2 to make an exposure concentration of 500 ppm.

8. Add 500 μl of the stock solution to Test Trial 3 to make an exposure concentration of 100 ppm.

9. Add 50 μl of the stock solution to Test Trial 3 to make an exposure concentration of 10 ppm.

10. Allow the *Daphnia* to grow for three days. Each day, count the number of survivors in each of the beakers and record the number in your data table.

Simplified *Daphnia* Anatomy



STUDENT DATA SHEET: Lead(II) and *Daphnia*

	DAY 1	DAY 2	DAY 3
Control			
Test Trial 1			
Test Trial 2			
Test Trial 3			
Test Trial 4			

Calculate the average number of survivors at each concentration

	DAY 1	DAY 2	DAY 3
Control			
Test Trial 1 1000 ppm			
Test Trial 2 500 ppm			
Test Trial 3 100 ppm			
Test Trial 4 10 ppm			

QUESTIONS

1. Estimate the LD_{50} for the *Daphnia* exposed to Lead(II).

2. Lead poisoning is common in humans. How does the toxicity of lead to *Daphnia* relate to the toxicity of lead to humans? Use the TRI Chemical Substance Fact Sheets to determine the exposure level for humans.

3. The *Daphnia* were exposed to lead ions dissolved in solution. How are humans usually exposed to lead?

4. Name two sources of lead contamination.

RECYCLING

SECTION 7 GOALS

7.1

FOCUS

You may use a newspaper as kindling to light a fire in your fireplace. The paper, like all materials, has energy stored in it. What other materials would be good as fire starters?

OBJECTIVE

To allow students to access the pollution prevention data contained in the TRI database. To examine industry methods of source reduction and energy recycling using the TRI data.

7.2

FOCUS

Paper or plastic? Reduce, reuse, recycle. The language of recycling is commonplace in today's society. What items are commonly recycled? What are their characteristics?

OBJECTIVE

To distinguish between the different types of commonly used plastics. To identify household plastics in terms of type and whether they can be recycled.

Every high school student should be familiar with the saying, "Reduce, Reuse, Recycle." In today's world, many shoppers prefer buying items in bulk to minimize packaging; students may carry reusable lunch bags instead of paper; and it has become a common household practice to separate items into different solid wastestreams: recyclable plastics, cans, newspapers and glass. Some consumers, however, do not think beyond the waste they generate. Many people are unaware that large industries look for creative ways to recycle the waste produced in their manufacturing processes.

The Pollution Prevention Act (PPA) of 1990 established a national policy of pollution prevention as the first choice of waste management practices. This strategy involves reducing the amount of waste at the source, and recycling wastes on-site. Starting in 1991, the TRI database contains additional data from facilities, including the amounts of chemicals recovered from manufacturing processes and recycled; chemicals used for energy recovery (burning the chemical to degrade it, and provide heat for manufacturing processes); and waste treated on-site.

Recycling Methods

Depending on time and the number of computers you have available, you may want to perform the TRI search prior to class, and provide students with records.

ANSWERS

1. Answers will vary according to site.
2. Environmental clean-up costs are reduced. The materials may provide additional sources of materials and energy.

EXTENSION

1. Discuss the issues related to recycling with your class, such as: source reduction; cost reduction; reducing on-site pollution; analyzing the costs and benefits of recycling a particular material; and deciding whether it is more practical, or even possible, to recycle on-site, versus paying for removal. Have some students role-play being owners and directors of manufacturing companies faced with these decisions. Have other students role-play being members of the town council who must decide which of those manufacturers they would allow to move to their town. (See *Database Basics* Activity 10 for more background about this type of activity.)

ACTIVITY 7.1

You may want to introduce students to basic database search concepts before beginning this activity. One way to do this might be to distribute copies of Introduction to Data and Databases on pages iv to vi of *Database Basics*. This activity also presents an opportunity for developing students' decision-making abilities; *Database Basics* Activity 10 explores a decision-making format you might adapt to this activity.

Recycling Methods

This activity is designed to show you how to access the pollution prevention data contained in the TRI database.

PROCEDURE

1. Open the 1990-1994 TRI database. From the **F3=Select** menu choose **Reporting Year** and highlight 1994.

2. From the **F2=Options** menu set **Search Set: to Last Set Created**. From the F3=Select menu choose **Facility State** and enter your state. From F3=Select choose **Source Reduction Activities**.

3. Display the entries. Choose three records and complete the following chart.

Student Data Report: Recycling Methods

Facility Name: ____________________
Chemical Name: ____________________
Maximum amount on-site: ____________________
On-site Energy Recovery, Current Year: ____________________
Off-site Energy Recover, Current Year: ____________________
On-site Recycling, Current Year: ____________________
Off-site Recycling, Current Year: ____________________
On-site Treatment, Current Year: ____________________
Off-site Treatment, Current Year: ____________________
Source Reduction Activities: ____________________
Source Reduction Methods: ____________________

QUESTIONS

1. For each of the facilities, express the amount recycled as energy as a percent of the total amount recycled.

2. Describe two reasons why you think it is economical to reuse or recycle waste on-site rather than throwing chemicals away.

Identifying Plastics

For this activity, you will need to provide samples of each type of plastic for your class. Make your samples large enough so students can cut small pieces for their tests, and try to choose unknown samples that do not look like types of plastics your students might recognize. You may also want to divide your class into groups of two to three students for this activity.

The homework assignment is a good way for students to learn about the characteristics of plastics they use in their daily lives. You should have an open class discussion of the various types of plastics they found in their homes. Write down the plastic codes and characteristics on the blackboard, and then fill in any of the types the students didn't find. Discuss the various types of plastics and their characteristics.

TYPES OF PLASTIC

CODE 1 Polyethylene terephthalate (PET): Commonly used for soft-drink bottles. Transparent, flexible, and rigid. Will crack but not shatter. Recycled into fiber fillings, carpeting, and epoxies such as surfboards and boat hulls.

CODE 2 High Density Polyethylene (HDPE): Commonly used for milk jugs, bleach bottles, and water bottles. Opaque with a rough surface. Stiff but will bend. Recycled into drain pipes, lumber substitutes, toys, and flower pots.

CODE 3 Polyvinyl Chloride (PVC): Commonly used for plastic wrap, drain pipes, shower curtains, and vinyl car parts. Glossy, difficult to burn, and may be either rigid or flexible. Recycled as floorings and truck bed liners and tool boxes.

CODE 4 Low density polyethylene (LDPE): Commonly used for condiment bottles, plastic bags, and coffee can lids. Opaque and very flexible. Recycled as insulation and used in making mixed plastics.

CODE 5 Polypropylene (PP): Commonly used for bottle caps, the bottoms of soda bottles, and candy wrappers. Translucent to opaque with smooth surfaces which may reflect light (have luster). Commonly recycled as park benches and fencing.

ACTIVITY 7.2

You may wish to have students create flow charts of more commonly-known topics prior to conducting this activity; *Database Basics* Activity 1 has a procedure for developing a flow chart for a library. This activity also presents an opportunity for developing students' decision-making abilities; *Database Basics* Activity 10 explores a decision-making format you can adapt to this activity.

CODE 6 Polystyrene (PS): Commonly used for drinking cups, eating utensils, deli and fast food containers. Transparent or opaque, and it may be semi-rigid, brittle, or a foam. Polystyrene is not recycled.

CODE 7 Mixed Plastics: are made by combining the other classes of plastics. Characteristics vary widely. Mixed plastics are not recycled.

TEST RESULTS

1. Densities of Common Plastic Types

CODE	SAMPLE TYPE	DENSITY G/ML
	Water	1
1	PET	1.38-1.39
2	HDPE	0.95-0.97
3	PVC	1.16-1.35
4	LDPE	0.92-0.94
5	PP	0.90-0.91
6	PS (rigid)	1.05-1.07

2. A green color indicates the presence of a halogen.

3. Styrene will swell in the acetone.

4. PET will soften.

6. LDPE burns slowly and blue, PP burns quickly and yellow.

ANSWERS

1. Efficiency in collection and processing, and a demand for the process and/or the recycled products.

2. Answers will vary.

3. Different types of plastic have specific properties that define what it could, or could not, be used for.

EXTENSIONS

1. Arrange for a tour of a local recycling facility if one exists in your area. Students will be able to see how plastics are sorted and processed for reuse.

2. Many municipal and county governments have a recycling coordinator who oversees the local recycling program. Invite this person to visit the class to discuss the community's efforts and answer questions from students.

3. Assign students to write reports in which they investigate questions they may have about recycling. For example, what are the environmental benefits and costs of recycling? Is recycling less or more expensive than throwing waste in a landfill or burning it in an incinerator? What would be needed to recycle more types of plastics?

4. What products are recycled in your community?

a. Pick one product, and trace it from manufacturing to the waste stream. Is the path circular, product is recycled, or linear, product ends up in a landfill.

5. Bring several packaged items to class. (The packaging can be of any type, and the items should not be visible during the activity.) Ask students to determine why the manufacturer chose the particular packaging for each product. Can they identify potentially less-wasteful types of packaging for any of the products. This extension can be done in class or as a take-home assignment.

Plastics Recycling

IDENTIFYING PLASTICS

Plastics are very much part of our everyday lives. They hold the beverages we drink,keep our food fresh, carry water to our homes, and perform a number of other functions that we probably take for granted. Plastics come in a wide variety of shapes, sizes, and types.

As recycling has become more widespread, manufacturers have begun placing identification codes on the bottoms of most plastic containers. The codes include a letter designation and a number inside of a recycling symbol. Because not all plastics are recyclable, the codes identify the specific type of plastic and its recyclability.

PLASTICS IN THE HOME

For homework, identify the different types of plastics that your family uses on a regular basis. There are seven types of commonly used plastics; try to identify as many as you can. Prepare a list that identifies the product's code, how it is used, and the main characteristics of the plastic. Is it clear or opaque? Is it rigid or does it bend easily?

You should be prepared to discuss your list in class. After the discussion, you will conduct experiments on different samples of plastics to better determine their physical and chemical properties. You will test known samples as controls, and then test unknown samples against your results.

MATERIALS

Samples of the seven plastic types
Three unknown plastic samples

PROCEDURE

1. Obtain one sample of each type of plastic and label them accordingly. Carry out each of the tests on a separate small piece of each known sample, and record your results. Use your findings to create a flow chart.

2. Obtain each of the three unknown plastics. Test them to determine their properties, and compare your findings to your flow chart. What are they?

TESTS TO DETERMINE TYPE

1. Specific Gravity: Submerge the sample in water. Make sure no air bubbles are adhering to the surface of the plastic. Record whether the density is greater or less than water.

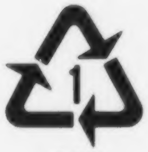
2. Copper Wire Flame Test: Using tongs, hold a copper wire in the flame of a Bunsen burner until it is red hot. Push the hot wire through the plastic sample. Place the wire back in the Bunsen burner flame, observe and record the color that comes from the wire.

3. Acetone test: Cover the sample in acetone in a small beaker. Observe any change in the surface of the plastic. Record a "+" if any reaction occurs and a "-" for no change.

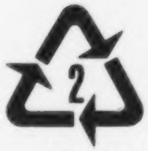
4. Heat test: Using tongs place the sample in boiling water for 3 minutes. Record as "+" for softened and a "-" for no change.

5. Isopropyl alcohol test: Cover the sample in isopropyl alcohol in a small beaker. Record whether the sample floats or not.

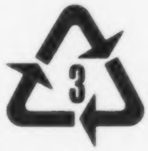
6. Combustion Test: Cut a small corner off of the sample. Use tongs to hold it in the flame of the Bunsen burner until it ignites. Remove the sample from the flame and observe and record its color.



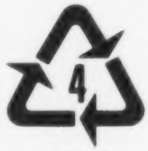
PET



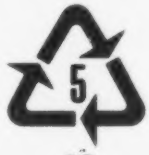
HDPE



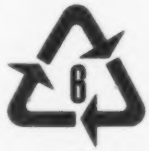
V



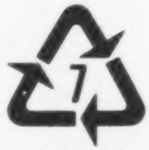
LDPE



PP



PS



OTHER

STUDENT DATA REPORT: Identifying Plastics

PLASTIC SAMPLE	SPECIFIC GRAVITY	CU WIRE	ACETONE	HEAT	ISOPROPYL ALCOHOL	COMBUSTION
PET						
HDPE						
PVC						
LDPE						
PP						
PS (rigid)						
Unknown #1						
Unknown #2						
Unknown #3						

Unknown #1 is ____________________

Unknown #2 is ____________________

Unknown #3 is ____________________

QUESTIONS

1. What factors must be present to make plastic recycling economically feasible?

2. Name three plastic items that you used today that may have been made from recycled plastic. What type of plastic do you think was used?

3. Why is one type of plastic used for one product and not another?

Chemicals in the Household

CHEMICAL PRODUCTS	HAZARDOUS INGREDIENTS	POTENTIAL HEALTH AND ENVIRONMENTAL EFFECTS	POSSIBLE ALTERNATIVES AND HINTS*
Toilet Cleaners	Muriatic (hydrochloric) acid Oxalic acid Paradichlorobenzene Calcium hypochlorite	COR, MECO K, COR, MECO L, N, K, MECO K, MECO	Toilet brush and baking soda; Mild detergent; Vinegar soak for tub and sink finishes. Avoid direct skin contact and breathing of fumes.
Drain Cleaners	Sodium or potassium hydroxide Sodium hypochlorite Hydrochloric acid Petroleum distillates	COR, IR, MECO COR, MECO COR, MECO CAN, D, MECO	Plunger; Flush drain with 1/4 cup baking soda and vinegar. Avoid direct skin contact and breathing of fumes.
Oven Cleaners	Potassium or sodium hydroxide Ammonia	COR, IR, MECO HECO, COR, IR	Baking soda and water; Avoid direct skin contact and breathing of fumes.
Bleach Cleaners	Sodium or potassium hydroxide Hydrogen peroxide Sodium or calcium hypochlorite	COR, IR, MECO MECO COR, MECO	1/2 cup of white vinegar or baking soda for laundry. Avoid direct skin contact and breathing of fumes.
Dishwashing Detergent	Chlorine Surfactants	LU, CAR, IR LU, CAR, IR, MECO	1 part borax to 1 part baking soda. Handle all cleaning solutions with care.
Ammonia-based Cleaners (All-purpose cleaners)	Ammonia Ethanol	COR, IR, HECO D, L	Vinegar and salt-water mix for surfaces; baking soda and water.
Glass Cleaners	Ammonia Naphthalene	D, L, MECO CAN, IR	Wash windows with 1/4 to 1/2 cup white vinegar to 1 quart warm water. Rub dry with newspaper.
Fabric Softener	Ammonia Cationic Surfactants	COR, IR, MECO HECO	1 cup white vinegar or 1/4 cup baking soda in final rinse water.
Air Fresheners	Cresol Phenol Formaldehyde	IR, SEN, L, K, LU, MECO IR, SEN, L, K, LU, MECO IR, SEN, L, K, LU	Open box of baking soda or dish of vanilla; simmer cloves. Open windows or use exhaust fans.
Laundry Detergent	Surfactants	IR, LU, MECO	Avoid breathing powder.
Mothballs	Naphthalene Paradichlorobenzene	CAN, IR, MECO L, K, N, CAN, MECO	Cedar chips; newspapers, lavender, flowers, or other aromatic herbs and spices
Rug and Upholstery Cleaners	Naphthalene Perchloroethylene Oxalic acid Diethylene glycol	CAN, IR, MECO K, D, R, N, CAN K, COR, MECO D	Baking soda on rug. Then vacuum.
Floor and Furniture Polish	Diethylene glycol Petroleum distillates Nitrobenzene Mineral spirits	D CAN, D R, CAR, L, MECO CAN, D	1 part lemon oil, 2 part olive/veg oil. Vegetable oil soap.

continued on page 70

Chemicals in the Household, *continued*

CHEMICAL PRODUCTS	HAZARDOUS INGREDIENTS	POTENTIAL HEALTH AND ENVIRONMENTAL EFFECTS	POSSIBLE ALTERNATIVES AND HINTS*
Furniture Strippers	Acetone	FLAM, D, R, N	Equal portions of boiled linseed oil, turpentine, and vinegar with steel wool. Sandpaper or heatgun. Use in well-ventilated areas or outdoors. Handle all solvents with care.
	Methyl ethyl	D, R, N	
	Ketone	D	
	Alcohols	D	
	Xylene	N, K, L	
	Toluene	N, K, L, D	
	Methylene chloride	CAN, L	
Stains/Finishes	Mineral Spirits	CAN, D	Natural earth pigment finishes. Use in well-ventilated areas or outdoors. Handle all dyes and paints with care.
	Glycol ethers	D, R, BL	
	Ketone	D, R, N	
	Halogenated hydrocarbons	CAN, D, R, N, L, HECO	
	Naphtha	CAN, D	
	Xylene	N, K, L	
	Toluene	N, K, L, D	
Enamel or Oil-based Paints	Pigments	CAN, D, SEN, MECO	Water-based paints if appropriate; Always use in well-ventilated areas.
	Aliphatic Hydrocarbons	CAN, L, K	
Latex Paint	Mercury	N, D, R	Handle all paints with care.
Antifreeze	Ethylene glycol	N, K, D	Clean up all spills.
Automobile batteries	Sulfuric acid	COR, MECO	Bring old batteries to recycling center. Avoid direct skin contact. Wash spills with plenty of water.
	Lead	BL, N, D, CAN, HECO	
Automobile Lubricants (transmission and brake fluids, used oils)	Hydrocarbons (benzene)	N, CAN	Seal used oil in plastic container and bring to recycling service station.
	Mineral oils	D, CAN	
	Glycol ethers	D, R, BL	
	Heavy Metals	N, AC, K, L, CAN, MECO	

NOTES:

- * The above listed alternatives are offered as options and are not presented as recommended courses of action.
- * Several listed alternatives are also potentially hazardous and can cause harm if handled improperly.
- * Various commercial products which fall into the product categories listed here may not contain all of the listed chemical constituents.

KEY TABLE:

AC	Acute toxicity
BL	Blood effects
CAN	Cancer
CAR	Cardiopulminary injury
COR	Corrosive
D	Developmental toxicity (birth defects, fetal toxicity)
FLAM	Flammable
HECO	High ecotoxicity
IR	Irritant
K	Kidney toxicity
LU	Lung effects
MECO	Moderate ecotoxicity
N	Neurotoxicity (nerve toxicity/poison)
R	Reproductive toxicity (sterility, decreased fertility)
SEN	Sensitization (immunological toxicity, allergic response)

Bibliography and Resources

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Spooner, Barbara and Jay Barracato. *Teach With Databases: Database Basics.* Arlington, VA: National Science Teachers Association, 1998.

Stapp, William B., Mare M. Cromwell, David C. Schmidt, and Andy W. Alm. *Investigating Streams and Rivers.* Dubuque, IA: Kendall/Hunt Publishing Company, 1996.

United States Environmental Protection Agency. *Toxics Release Inventory, 1987–1993 CD-ROM User's Manual.* Washington, DC: United States Government Printing Office, 1995.

INTERNET RESOURCES:

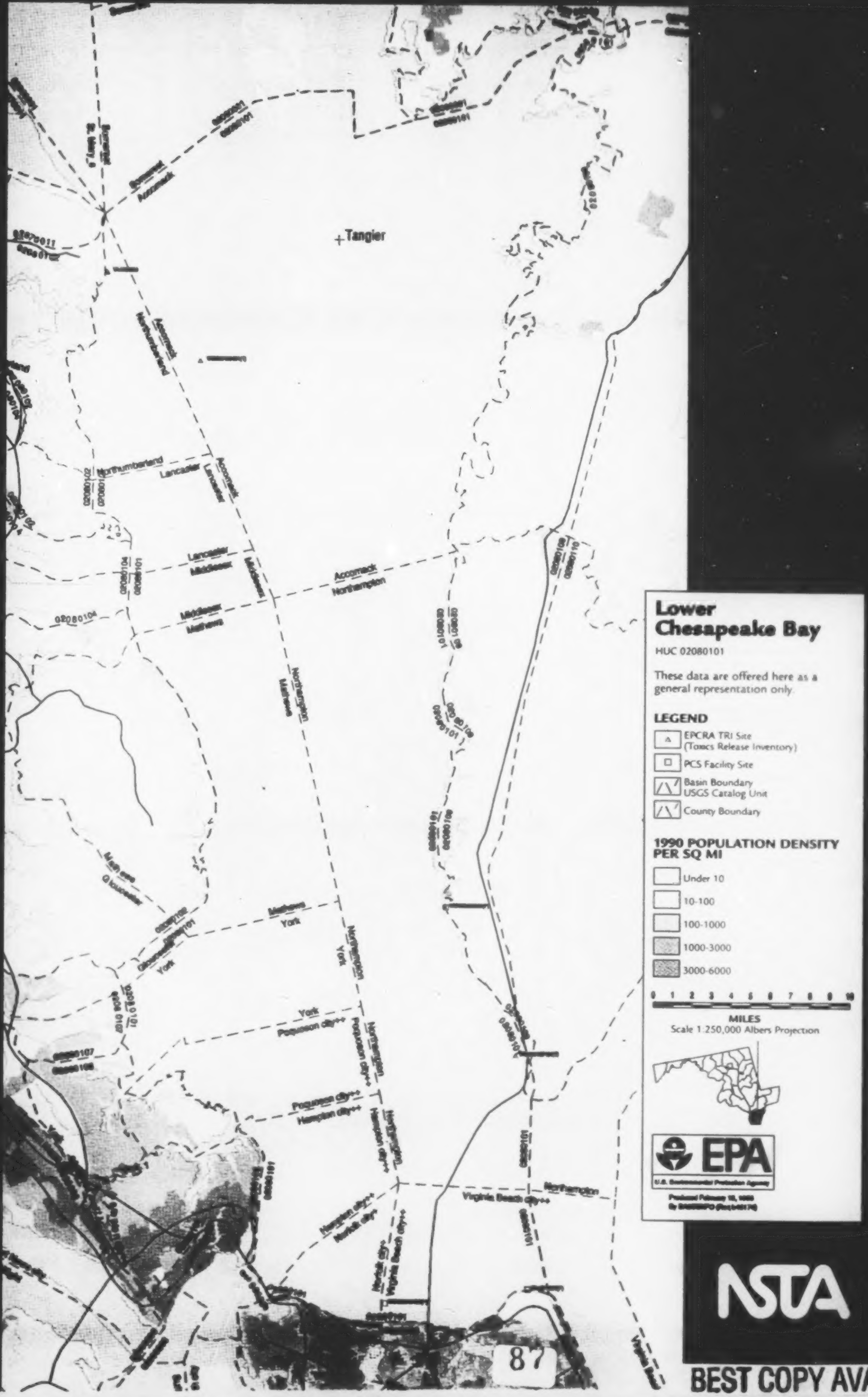
U.S. Environmental Protection Agency: http://www.epa.gov

Surf Your Watershed: http://www.epa.gov/surf

U.S. Geological Survey: http://www.usgs.gov

Environmental Mapping and Assessment: http://earth1.epa.gov/emap/

Recycler's World, Plastics Recycling Section: http://www.recycle.net/recycle/Plastic/index.html


Tangier
Somerset
Accomack
Northumberland
Lancaster
Middlesex
Mathews
Northampton
Gloucester
York
Poquoson city++
Hampton city++
Norfolk city++
Virginia Beach city++
02080101
02080102
02080104
02080107
02080108
02080110
0 1 2 3 4 5 6 7 8 9 10
MILES

Lower Chesapeake Bay

HUC 02080101

These data are offered here as a general representation only.

LEGEND

- △ EPCRA TRI Site (Toxics Release Inventory)
- □ PCS Facility Site
- Basin Boundary USGS Catalog Unit
- County Boundary

1990 POPULATION DENSITY PER SQ MI

- Under 10
- 10-100
- 100-1000
- 1000-3000
- 3000-6000

Scale 1:250,000 Albers Projection

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SKILLS BOOK

Database
BASICS

Activities

to explore

the use of

data and

databases

DATABASES

TEACH WITH
DATABASES

DATABASE BASICS

SKILLS BOOK

BY

BARBARA SPOONER

AND

JAY BARRACATO

PUBLISHED BY
NATIONAL SCIENCE TEACHERS ASSOCIATION
WITH SUPPORT FROM
U.S. ENVIRONMENTAL PROTECTION AGENCY

NSTA Stock Number PB142X
Library of Congress Catalog Card Number 98-84910

ISBN 0-87355-170-2

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Scientists rely on technology to enhance the gathering and manipulation of data.

—*National Science Education Standards*

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Student inquiries should culminate in formulating an explanation or model. Models should be physical, conceptual, and mathematical.

—*National Science Education Standards*

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Science and technology are essential social enterprises, but alone they can only indicate what can happen, not what should happen.

—*National Science Education Standards*

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Introduction to Data and Databases

Scientific literacy enables people to use scientific principles and processes in making personal decisions and to participate in discussions of scientific issues that affect society.

—*National Science Education Standards, page ix*

Data are all-important in today's society. Data are collected for every conceivable event—from the daily weather report, to the results of sporting events, to daily events in the workplace and school. However, the power of data comes not from simply listing it, but from using using it to make predictions, develop decisions, and better understand our world. Traditionally the language of statistics has been daunting to many students and teachers alike. Now, new methods which rely greatly on graphical rather than algebraic techniques are opening the way for extensive student analysis of data. In addition, many sources of data are increasingly available to the public, as computerized and on-line databases become the norm.

These new sources of data and methods of data analysis are creating many new learning opportunities for all grade and skill levels. The purpose of this book is to present activities which will familiarize students with the presentation, manipulation, and analysis of data. As students perform these activities, they will become familiar with the language of data analysis and, hopefully, transfer these skills to all of their classroom activities.

WHAT ARE DATA?

Data are bits of information that are collected and stored in some way. Data are always collected to serve some purpose. For instance, many stores now ask customers for zip codes or area codes when making a purchase. The information is not enough to identify the customer, but it does provide the store with an idea of where their strongest and weakest markets are located. Many simple questions we are asked during the day are designed to provide data about our actions and preferences.

One piece of information by itself is not particularly useful. Large amounts of data when gathered, however, help establish existing trends and predict future trends. In order to perform these skills, it is important for the data to be organized. Databases organize data so that users can easily find what they need.

WHAT IS A DATABASE?

A database is a collection of similar types of information. While today "database" usually refers to data stored within a computer program, they can take any form. All databases have several common attributes, including an organizational system, searching methods, and the ability to sort information.

Phone books provide a great example of a database. Phone books contain names, addresses, and phone numbers. In addition, many phone books include information on businesses. Each type of information, like a name or address, is referred to as a field. Each field holds only one piece of data. A record contains several such fields. A phone book record, for example, holds the name, phone number, and address fields. A database is the collection of all these records.

In addition to simply listing data, databases allow us to perform two extremely valuable functions: searching and sorting. Searching a database involves looking through the records for a particular value in a particular field. Because residential phone books are organized alphabetically by last name, a person looking for someone's phone number would first search the name field. Once the name field is found, all the information in that record is available, including the field which contains the phone number. Business directories, such as the Yellow Pages, sort by business type or category. Once the listing for a business is found, all of the records—including phone numbers—are available.

Computers can aid the search process, especially when a database contains a considerable amount of information. Most computer databases allow data to be searched or sorted by any field. Imagine an interactive phone book that would let you instantly list all the phone numbers of your softball team, and then just as easily all the pizza delivery places in town.

In addition to searching and sorting data, many computer databases can cross-reference information. A familiar example is a library's check-out system. Part of the database holds the records of the library's holdings (books and other materials). Another part of the database contains the records of people with checkout privileges. The database constantly cross-references records of which patrons have which books. Librarians can use the cross-reference function to identify all the books checked out by an individual or a group of people. Databases with a cross-referencing function allow for this type of elaborate search.

Another reason computerized databases are useful is that they allow for Boolean searches. Boolean searches allow the database user to establish search criteria in more than one field. While Boolean logic and set theory is beyond the scope of this book, database users should be aware of two basic searching methods: the "AND" and the "OR." A search using the AND operator will return records that meet the conditions in two fields specified in the search. A search using the OR operator will return records that meet the conditions set in either of the fields searched. This same result can be accomplished by doing sequential searches, where a search is performed on the results on another search. An example of a sequential search would be checking the card catalog for all the books on a particular subject, then using that list to check which books are presently in the library. Both searches and sorts are highly effective in helping us reach our goal of analyzing existing trends and predicting future trends.

MANIPULATING DATA

All too often, students are distracted from the importance of a set of data by the rigors of trying to interpret the data. For data analysis to be of use, it must enhance understanding rather than create a distraction. For these reasons, data analysis skills should be taught before the technique is applied to data from which students are expected to draw important concepts. For example, graphing techniques are usually taught early in the school year. The objective is to learn solid technique before actually working with data.

Once a set of data has been searched or sorted, a student must choose the most appropriate way to analyze the data. That method depends both upon the format of the data and the desired interpretation. The analysis methods outlined in this book are important tools for working with scientific data, and are not especially mathematically daunting. The goal is to make sense of data without bogging students down with algebra. However, in order to look at the ways data can be manipulated, a mathematical vocabulary must be established. Common mathematical terminology is therefore used and defined throughout the text. It is necessary that the student become familiar with the appropriateness and limitations of data analysis methods, so that they can be confident in how they interpret their data.

CONFIDENCE IN DATA

Many of the techniques described in this book also help determine the confidence that can be placed in data. Error analysis can be confusing to students, but the graphical methods in Section Two, pages 17-33, provide easy techniques for identifying and reporting variations in data. While the graphical methods do not have the rigor of algebraic methods of analyzing error, they do provide the students with a quicker, simpler method of interpreting data. Section Three, pages 34-46, further explores the concept of confidence from the standpoint of decision-making.

ANALYZING DATA

One of the most important steps in analyzing data is to ensure the correct data is collected. The problem most often encountered by students is struggling to draw an interpretation from data which does not include the answer they need. To avoid this pitfall, students first need to clearly state their hypotheses, including the relevant variables and the statistical methods which can answer it. The hypothesis must be one that can be supported by the statistical methods used. When a well-written problem and hypothesis are supported by a valid data set, analyzing the data becomes simple.

The statistical model (choice of analysis method) chosen for an investigation should reflect the type of information needed. Data can be analyzed to show trends within the data (interpolate), predict trends past the ends of the data (extrapolate), to show if a cluster of points is the same or different from another cluster of points, or to show relationships between variables (correlations).

About the *Teach With Databases* Series

The *Teach with Databases* series was developed by the National Science Teachers Association with support from the Environmental Protection Agency. It uses actual databases from the public and private sectors to teach students a broad range of data skills, and guides them through real-life applications of these skills. The scope of these data helps students understand the global importance of data gathered on a local level. The series addresses a wide variety of science disciplines, including chemistry, biology, geology, environmental science, and Earth science. Most of the concepts are applicable for more than one discipline, and can be utilized in several areas of the curriculum. The series was designed to provide teachers with the greatest level of flexibility, so that activities presented in any of these books might be adapted or expanded as needed.

The databases and their corresponding activities might be used as stand-alone units, science fair products, attention-grabbers before an in-depth study of a particular topic, or as a source of data for a class project. Additionally, *Database Basics* can be used to prepare students to work with data from their own investigations, other students' investigations, or any other databases they might need to use.

How to Use This Book

Because even the most advanced high school students may be database novices, it is recommended they first learn good data analysis techniques. Indeed, mathematics is an essential part of science inquiry. The *National Standards* recommends the use of hand tools, measuring instruments, calculators, and computers for the "collection, analysis, and display of data" (page 175). The concepts explored in *Database Basics* give students a sound foundation for future activities requiring more rigorous data analysis techniques.

To make it easier to determine which basic skills students should have before beginning a database activity, the books in the series are cross-referenced to *Database Basics*. Every activity in the Teachers' Guides highlights one or more *Basics* activities that can be conducted as preparation. And every activity in *Basics* lists the skills students will obtain through that activity. In addition, *Database Basics* can be used as a stand-alone curriculum unit, or adapted to prepare students to work with any data set.

While activities in this book can be used as a stand-alone units, each section is designed to augment skills and concepts learned in the previous section. The best preparation for working with a database would use one or more activity from all three sections, tailored to fit students' interests and educational needs.

The book contains three sections: "Creating Databases," "Working with Data Sets," and "Making Decisions Based on Data." These categories of skills correspond with the process of using a database: collection, analysis, and display of data. Specific skills taught in each section are listed on the opposite page. They are also closely linked to the *Standard*'s call for students to gain experience in "summarizing data, using language appropriately, developing diagrams and charts, explaining statistical analysis, ... constructing a reasoned argument, and responding appropriately to critical comments" (page 176).

The first section, "Creating Databases," helps students develop their understanding of databases. Activities introduce the concepts of audience, organization, static vs. dynamic, and basic surveying techniques. "Working with Data Sets" explores the formulas used for describing and analyzing data. It provides background material for teachers new to statistical analysis, and gives students a variety of methods for evaluating data. The third section of this book, "Making Decisions Based on Data," explores concepts in oral, written, and rhetorical communication. It gives students tools for communicating the results of their research, choosing appropriate graphs and charts, and forming logical decisions.

The activities use a combination of techniques to supply students with data. In some activities, students perform a brief survey to gather data. To maintain flexibility, data-collecting is typically limited to a single homework assignment which can be expanded if class time, interests, and skill level permit. Other activities provide ready-to-use, reproducible data sets so that attention can be focused on analysis and decision techniques. Most of these data sets are based on actual data. The premise of the *Databases* series is to provide students access to real-life data.

Outline of Data Skills Taught in *Database Basics*

SECTION 1

Creating Databases

Identifying ways databases are used for everyday purposes

Understanding the organization of a common database

Understanding why one database may use several organizational methods

Considering the advantages and disadvantages of computer and Internet databases

Understanding how databases are organized to suit an intended audience

Composing the parameters of a database based on its intended use and audience

Designing a strategy to collect data

Designing a method of storing and maintaining a database

Making database information accessible and easy to use

Creating written instructions for database users

Comparing categories of data

Identifying sampling error

Identifying trends in data

Understanding very large and very small numbers

Extrapolating data

Understanding dilutions, solutes, and solvents

Understanding toxicity

Working with parts per million

Working with concentrations

Working with data indicators

SECTION 2

Working With Data Sets

Drawing comparisons in absolute terms

Comparing different types of data

Understanding and quantifying mass

Describing data using statistical measurements: median, mode, and average

Identifying trends in data

Using the following data analysis techniques:

a. Range
b. Average
c. Standard deviation
d. Median score
e. Quartile
f. Examining distribution with stem-and-leaf plots
g. Examining distribution with box-and-whiskers plots
h. Identifying outliers
i. Establishing relationships between two variables
j. Examining distribution with scatter plots

SECTION 3

Making Decisions Based on Data

Identifying appropriate methods to graphically display data

Communicating scientific research

Explaining data using graphics

Identifying and researching the most relevant data

Preparing statistical summaries from a set of data

Understanding how statistics can be used for multiple purposes

Using statistics to present an argument

Making oral presentations based on database information

Using a scientific organization method to reach a logical decision

Learning how to weigh data when forming a decision

Identifying gaps in information

Making decisions without complete data

Understanding how public perception of risk may affect a decision

ABOUT THE AUTHORS

Barbara Spooner taught three years of math at the Emma Willard School in Troy, New York, and Edison High School in Alexandria, Virginia. Her experience covers all levels of high school math from pre-algebra to advanced placement calculus. She also has spent countless hours outside of class tutoring students individually. She graduated from Williams College with a B.A. in mathematics. She earned her Masters in Education at Harvard University where she concentrated in technology in education. While at Harvard, she developed the math section of an interdisciplinary curriculum implemented in Great Falls, Montana.

Jay Barracato considers himself a science teacher. Over the past six years at Patuxent High School in Calvert County, Maryland, he has taught chemistry, biology, Earth science, physics, and environmental science. Jay does independent work at Chesapeake Biological Laboratory on trace level analysis of chlorinated compounds in marine environments, and has involved his high school classes in raising hyperthermophilic *archaea* (bacteria similar to those found at hydrothermic vents). Jay has participated in the Maryland Governors Academy and the University of Maryland Graduate Fellows Program. His students use statistics to analyze real data they collect, and he uses on-line databases as a source of data in his classroom.

ACKNOWLEDGEMENTS

Many people helped develop *Teach With Databases*. First, Kathy Hogan of EPA, Ron Slotkin of EPA, Greg Crosby of USDA, Keith Wheeler of Global Rivers Environmental Education Network, and Steve Vandas of USGS provided advice on the content and concepts to be included. Kathy Hogan then designed a survey for science educators, and 92 NSTA members graciously responded with their plans and practices for using online data in their classrooms. Kathy Hogan rounded up the valuable EPA publications included with the *Teach With Databases* package.

During manuscript development, authors Barbara Spooner and Jay Barracato received able assistance from reviewers and colleagues, including Kathy Hogan, Greg Crosby, Rob Sugar, and Tom Wysocki. Christina Frasch contributed Activity 10, The Steps of Decision Making.

Project advisors and reviewers at EPA's Office of Prevention, Pesticides, and Toxic Substances were Georgianne McDonald and Odelia Funke. They coordinated the EPA technical review of *Teach With Databases*, and provided advice and encouragement throughout the development process.

Teach With Databases is published by the National Science Teachers Association, Gerry Wheeler (Executive Director), Phyllis Marcuccio (Associate Executive Director for Publications). *Teach With Databases* was developed and produced by NSTA Special Publications, Shirley Watt Ireton (Director of Special Publications), Chris Findlay (Associate Editor), Anna Marie Gillis (Associate Editor), Michelle Triestman (Assistant Editor), and Christina Frasch (Program Assistant). Project Editors for *Teach With Databases* were Christina Frasch for *Database Basics*, and Michelle Treistman for *Toxics Release Inventory Teacher's Guide*. Michelle Eugeni, Eric Knaub, and Doug Messier also provided assistance. *Database Basics* was designed by Sharri Harris Wolfgang of AURAS Design with production assistance from Robin Cather of AURAS Design, and printed by Automated Graphic Systems.

Exploring the Library Database

TIME MANAGEMENT

One classroom period for a library visit. The remainder of the activity can be adjusted to fit your schedule.

MATERIALS

Student Sheet, page 3

BACKGROUND

Organization is the primary trait shared by all databases. The method of organization, however, varies greatly. Ask your students what factors might affect how a database is organized. By precisely organizing materials, the library makes it possible to find specific texts without searching every shelf.

Even databases containing similar types of information may be organized differently. Libraries, for example, use either the Dewey Decimal System or the Library of Congress system—each has different benefits and drawbacks. (Dewey Decimal is simpler, while Library of Congress can better handle large quantities of books. Small libraries tend to use Dewey; larger libraries usually use Library of Congress.) Ask your school librarian to explain to the class which catalog system is used by the school library. Have students research the two systems, and find out the strengths and weaknesses of each. Discuss why different libraries use different organizational methods. How might the potential audience affect how a library is organized? How might it affect how another database is organized?

This activity helps students think about how and why data are organized. Also, because libraries are a database with which students are already familiar, the activity encourages students to identify the databases they may use on a daily basis. The writing/drawing homework exercise reinforces their learning and has students develop a definition of a database for future reference.

PROCEDURE

1. Schedule a class period in your school's library. During the first part of the class, the librarian can discuss how the library "database" is managed. How does its organization help users? Have students consider advantages and disadvantages of this method. Why might a method of organization work well in one situation, but not another?

2. During the second half of the library visit, have your students imagine that a stranger needs help finding a book. She has never used a library, and doesn't understand the word "database." Have each student write down a definition for a database, and write a paragraph explaining why a library is a database. They can then create a simple flow chart or diagram that explains how the library's search system is organized. Fig. 1.1, on page 2, shows a sample flow chart.

3. After students have finished their charts, have them exchange them with their classmates. Can their classmates follow them?

4. Ask students to complete a final draft of their diagram for homework, adding any necessary definitions or clarifications. They could also write one-page letters to the stranger to elaborate on their diagrams and explain the library's organization.

ANSWERS TO STUDENT SHEET

1. A database is a collection of data organized especially for rapid search and retrieval. School libraries organize books and other materials to aid student research.

ACTIVITY SUMMARY

Students use a common database (a library), develop a definition of a database, and explore database organization.

DATABASE SKILLS

Identifying ways databases are used for everyday purposes

Understanding the organization of a common database

Understanding why one database may use several organizational methods

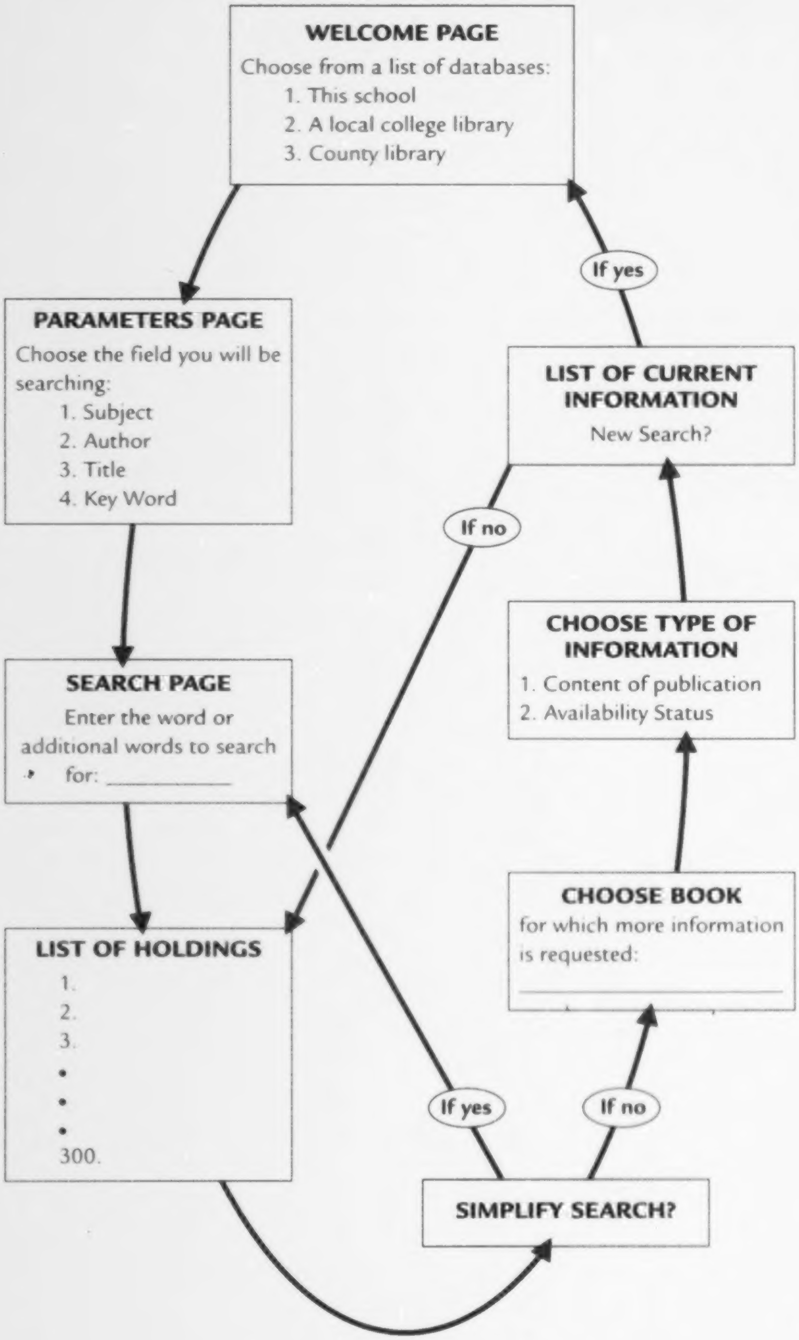
Considering the advantages and disadvantages of computer and Internet databases

Understanding how databases are organized to suit an intended audience.

NOTE: The activity calls for students to create written and graphical descriptions of databases. This constructivist format was developed from the *National Science Education Standards*, "Content Standards: 9–12," which recommends that "student explanations become a baseline for instruction as teachers help students construct explanations aligned with scientific knowledge" (page 172). Further information on using written and graphical techniques to supplement everyday science lessons can be found in NSTA's *How to...Write to Learn Science*. (See the Resources Section in Appendix E, page 52, for more information.)

FIGURE 1.1

Sample Flow Chart of a Library Search System


WELCOME PAGE
Choose from a list of databases:
1. This school
2. A local college library
3. County library
PARAMETERS PAGE
Choose the field you will be searching:
1. Subject
2. Author
3. Title
4. Key Word
SEARCH PAGE
Enter the word or additional words to search for: ___________
LIST OF HOLDINGS
1.
2.
3.
•
•
•
300.
SIMPLIFY SEARCH?
If yes
If no
CHOOSE BOOK
for which more information is requested:
CHOOSE TYPE OF INFORMATION
1. Content of publication
2. Availability Status
LIST OF CURRENT INFORMATION
New Search?
If yes
If no

2. One advantage is that information is accessible from multiple locations, both on-site and remote. Another advantage is that computer systems can be searched by keyword, as well as the more traditional categories of subject, author, and title. Also, computer systems can be instantly updated—one glance at a computer database can tell a user quickly whether the target book is checked out and when it is due back. However, computer systems are costly. Smaller libraries might not have the money to create and maintain a computerized database. Some patrons may be intimidated by computer technology, or be more comfortable with the traditional card catalog. And all computer systems have the potential to crash—an unfortunate scenario for a busy library.

3. Answers will vary, but may include date of publication, intended audience, and length.

4. Answers depend on which libraries students investigate, and the type of organizational method the libraries use. (This question might be used as an extra credit or extension exercise, or a longer-term homework project.)

Exploring the Library Database

1. Write a brief definition of a database. Why is your school library a database?

2. Today, a great number of U.S. libraries have converted their card catalogs into computer databases. Write a few paragraphs about how the computer system improves on the card catalog. What are the drawbacks?

3. List several nontraditional ways books and other library materials might be organized. Feel free to be creative!

4. Compare library sites online, in school, and in local libraries for ease of use, content, organization, and maintenance costs.

Creating a Database

ACTIVITY SUMMARY

Students design and create their own database as a class project.

DATABASE SKILLS

Composing the parameters of a database based on its intended use and audience

Designing a strategy to collect data

Designing a method of storing and maintaining a database

Making database information accessible and easy to use

Creating written instructions for database users

TIME MANAGEMENT

One class period to brainstorm the parameters of the database.

Two weeks outside of the classroom to research colleges.

One class period to compile data into a database.

MATERIALS

Student Sheet, page 6

BACKGROUND

A crucial component of database design is determining what information will be included, and what won't be. These limits, called parameters, are the set of values or constraints that characterize a set of information. Parameters keep databases from becoming unwieldy. Another important aspect of any database is whether it is static or dynamic. Static databases do not allow users to add or change any information—the database will always remain the same. Dynamic databases give users the option of revising data.

As students develop their own database, help them decide what type of parameters are appropriate. They can base their decisions on the time they have to do research, the availability of information, and/or the needs of the people who will be using their database. Encourage your class to give some thought to whether their database should be static or dynamic. Which is more useful? Which is easier to maintain?

In this activity, students will learn how to define and choose the limits of a database, research potential database components, and develop a method for combining and organizing data. The procedure below is based on college selection, but can be adapted depending upon students' interests and skill levels. Another option is to create a database around a topic students have been studying in class. You can also adapt this procedure to introduce future activities on a particular database.

PROCEDURE

1. Have the class brainstorm factors which may affect a student's choice of college. (Factors include cost, location, academic resources, handicapped accessibility, and campus aesthetics.)

2. Determine the parameters of the database. In this case, the parameters will be the types of schools that are included. Will the class include colleges from around the country or stick with local schools? Do they want to limit the database to four-year colleges, or include two-year colleges, community colleges, trade schools, and universities?

3. Have the class develop a list of specific schools they will include in their database.

4. Divide the class into groups of four or five students, assigning each group several schools to research. (Or let each group select their schools, making sure that no two groups research the same schools.)

5. Out-of-class research might take one or two weeks, depending upon how large the database will be. During this time, students should research the schools, and gather information about the criteria they chose in Step 1. Sources of information include college admission departments, the colleges' Internet sites, local book stores, libraries, and your school's academic advisors.

6. Once all the information has been gathered, have the class decide what

medium they will use. Should the database be stored on a computer or written on paper?

7. Before the database is built, the class should also decide how the information will be organized. Once they have answered all these questions, have them build their database.

8. Lead a discussion about the best way for people to use the database. First-time users might need some initial guidance. One way to set up a database is to have database users fill out a questionnaire to help them rank their priorities. Users could then use these priorities to search the database. Have students compile an introduction, questionnaire, or other type of guide to using the database.

9. Place the introduction and database in a location—such as the school library or guidance office—where they are accessible to students selecting colleges. If your school has an Internet site, you might also be able to create a link to the database.

10. (Optional) Have the class interview students who used the college database. Did they find it helpful? What features did they like about the database? What suggestions do they have to make the database easier to use or more helpful? Have the class revise the database to address this feedback.

ANSWERS TO STUDENT SHEET

1. Answers will vary, but should display a basic understanding of static and dynamic databases. An example of a static database is one which records water quality in a particular year; there is no need for revision once all the data are collected. An example of a dynamic database might be one which lists car safety records; it could be updated each year with new car models and the latest safety records.

2. Answers will vary. Examples include:

a. a database maintained by an environmental advocacy group (It would likely have unlimited accessibility so that information can be shared and their positions furthered.)

b. a database with information about books published by a consortium of 100 different companies (Publishers themselves might be able to update their own information whenever necessary.)

c. a database with data collected from only one investigation, survey, experiment, etc. (Because this information is so specific, the database would likely be updated only by the group that maintains it.)

3. Answers will vary.

Creating a Database

1. Imagine the chaos if anybody could, on a whim, add or remove books from your town library! Static databases are created at a specific point in time, and the data are never updated. A dynamic database is updated periodically. Give an example of each, and decide whether your college database should be static or dynamic. Explain your decision.

2. If you chose to make your college database dynamic, who would be able to update it? The information in some databases may be altered by anyone, others may be altered only by the group that maintains it. Database creators must decide who will have access to change information. Consider the following types of access (in terms of updating and/or changing data):

a. unlimited accessibility: general public is able to update any and all information
b. slightly limited access: only some groups or individuals are able to update information
c. limited accessibility: only the group that maintains the database is able to update information

In the space below, list three hypothetical databases that are good examples of each of these different forms of access.

3. As the Internet becomes an increasingly viable place to house databases, the public is re-examining the limits of personal privacy. What constraints, if any, do you think there should be on information available over the Internet? Why?

Generating Data from Sample Populations

TIME MANAGEMENT

One class period to introduce concepts and conduct class survey.

One night of homework for family survey.

One class period to compile family data.

One night of homework to create data tables and answer questions on student sheet.

MATERIALS

Student Sheet, pages 9-12

BACKGROUND

This activity will help develop students' ability to compare data columns, to extrapolate data to a larger set, and to make decisions based upon their interpretation of that information. In this activity, students survey their classmates and families about their favorite television shows, although you might adapt the surveying techniques to any subject.

Because this may be the first time your students have ever conducted a survey, take some time to discuss how surveys are conducted. This discussion might be a good opportunity to introduce the concept of "margin of error." Surveys almost always take into account the potential for inaccuracy, or sampling error.

Sampling error is very different from measurement error. Measurement errors are problems with the actual surveys or measurements that are taken, rather than with the sampling set.

Gallup polls use a sample size of 1,329, which may sound pretty small. It's only possible to generalize from such a small sample to 150,000,000 people because Gallup has developed very sophisticated models and very precise ways of getting a sample that has the proper demographics.

Another way to avoid sampling error is to survey the entire set. If you need to know the reading level of all Americans, and you give every American the same reading test, you are testing the whole population. Whatever results you obtain are real. As you get closer and closer to testing a whole set, you get fewer and fewer chances of being wrong.

Another method is multiple sampling. Because no single method is foolproof, combining sampling methods helps surveyors obtain more accurate data. For example, students have probably heard a news reporter make an announcement such as, "about one million people attended the rally." Estimates like this often use a combination of aerial photography, counts from people on the ground, and statistical extrapolation.

Sometimes more unusual techniques are called for: in 1990, the U.S. Census Bureau sent thousands of workers into the streets to count the homeless people who would not otherwise show up in that year's census—which is usually conducted by mail. Ask students why it is important that a survey identify its sampling errors.

Can your students identify ways to decrease the sampling error in the survey they are about to conduct?

PROCEDURE

1. Teacher Preparation

a. Find out how many people live in your community—the information is available through your town's local library, municipal office, or town hall. If you have time to do further research, locate data about your community in the U.S. Census Bureau's *State and Metropolitan Area Data Book*, or *County and City Data Book*. These books feature demographic, economic, and

ACTIVITY SUMMARY

Students survey their class and family to generate a set of data, extrapolate their findings to their community, and identify trends within the data.

DATABASE SKILLS

Comparing categories of data

Identifying sampling error

Identifying trends in data

Extrapolating data

TEACHING TIPS

You may wish to have students gather more information about census-taking, population studies, and extrapolation techniques. It could prove interesting to include faculty from your school's Social Studies department in these and other research exercises. Other resources include:

- **Nielsen Media Research's Communications Department, which can by reached by calling 212-708-7500, through their website (http://www.nielsenmedia.com), or by writing the company at: 299 Park Avenue, New York, NY 10017.**
- **U.S. Census information, which may be accessed through the U.S. Department of Commerce, Bureau of the Census home page at http://www.census.gov/.**
- **Zero Population Growth, an advocacy group which maintains a platform linking to groups and organizations around the world engaged in population, demographic, and census studies. Their Internet address is http://www.igc.apc.org/zpg/popinfo/.**

governmental data for the purpose of multi-county comparisons or single county profiles. You might also visit the Census Bureau's home page at http://www.census.gov/.

b. If the only information available is population size, approximate the percentages of males and females in each age bracket.

c. If you can locate specific information about your community's demographic structure, incorporate those categories into the television survey. For example, if you have data on your community showing what percent has degrees from high school, two-year colleges, four-year colleges, etc., students can record the education levels, in addition to gender and age, of those they survey. The more data categories you use, the more opportunity students have to compare categories.

d. Select 10 current television shows that the survey should rate. Include shows you think might appeal to varying age and gender groups. Also, try to select shows from various time slots—include shows that are on during the morning, during the day, during the evening, and "late-night" shows. (Be sure to select shows all students can watch, rather than those limited to cable.)

2. Reproduce the table on the Student Sheet, page 9, so that each student has two copies.

3. Have students label one table "Table A," and list 10 current television shows in the boxes on the left of the table. Select 10 students to rate them. The students should give each show a rating from 0 to 100 according to the scale below the table. Each student should work independently, so that nobody knows the ratings until everyone is finished. Rather than writing the students' names, however, have students describe themselves by their gender and age bracket. (Instead of writing "Susan," describe her as "female, age 11-19.")

4. Students can then label the second table "Table B," and list the same television shows in the left column of table. Ask them to bring Table B home and survey their family. As in the class survey, interviewees should be identified by their gender and age bracket. (If you have chosen to have students work with additional data categories, ask them to also identify interviewees by that category. For example, if you have added the category of education level, "Dad," might be identified as "Male, age 35-50, Bachelors degree.")

5. The next time class meets, have students compile their family survey results into one set of data.

6. Have students conduct the "Opinion Poll Mini-Activity" on their Student Sheets. (Explain that they will be using the same method for finding out what their community is watching on television.) As students conduct the pre-activity, reproduce the survey results so that each student has a copy.

7. Give students the demographic information about your community's population, and have them extrapolate their findings.

8. For homework, ask students to create three tables: one displaying class results, one displaying family results, and one projecting the community's favorite shows. The tables can take any format students prefer, as long as they clearly display the data. Students might wish to provide legends to help clarify their tables.

ANSWERS TO STUDENT SHEET

Opinion Poll Mini-Activity

1. Extremely concerned: 43 percent, fairly concerned: 28.5 percent; not at all concerned: 28.5 percent.

2. If 3 out of 7 were extremely concerned, then 3 = X% of 7, or 43%, which can then be extrapolated to 43% of 49 = number of people extremely concerned.

3. Twenty-one people were extremely concerned, 14 people were fairly concerned, and 14 people were not at all concerned.

Questions

1. Sampling error is very different from measurement error. Measurement errors are problems with the actual measurements that are taken, rather than with the sampling set.

2. Answer depends on data.

3. Answer depends on data. Students should identify the time slot with the majority of popular shows.

4. Answer depends on data. Students should identify the show that appeals most to men of all age groups.

5. Answer depends on data. Students should identify the show that appeals most to young children or parents with young children.

6. Answers will vary. Students may write that the data could have been more accurate had they surveyed a larger sample of the entire community.

7. Answers will vary.

TV Show (name and time)	Rater 1	Rater 2	Rater 3	Rater 4	Rater 5	Rater 6	Rater 7	Rater 8	Rater 9	Rater 10

THE RATING SYSTEM:

90-100	excellent
70-89	good
50-69	fair
30-49	poor
0-29	terrible.

AGE BRACKETS:

1-10
11-19
20-29
30-39
40-49
50-59
60+

Generating Data from Sample Populations

OPINION POLL MINI-ACTIVITY

In a recent opinion poll, seven people out of a 49-person group were asked, "How concerned are you about global warming?" Three people said "extremely concerned," two people said "fairly concerned," and two people said "not concerned at all."

1. What percent of the respondents were extremely concerned? Fairly concerned? Not at all concerned?

2. Assume that these seven people were a good representation of the entire group. Devise a method to extrapolate your data to the entire group.

3. Use this method to find out how many people of the group were extremely concerned, fairly concerned, and not concerned.

QUESTIONS

1. Explain the difference between sampling error and measurement error.

2. After completing the survey activity, use your data tables to answer the following questions:

a. Which shows were most popular?

b. Who watched these shows? Calculate percentages for each show, based on age and gender. (Use the same method you developed in the mini-activity.)

c. Which age bracket tends to have the most varying tastes in television shows?

d. Which show is ranked as "excellent" by the most disparate age brackets?

e. Which age bracket tends to have the most different preferences from the other age brackets?

f. Describe how your class data differs from the family data.

g. What trends can you identify in your data? Please describe the trend and provide a possible reason.

3. Based on your data, when is the most expensive air time that advertisers can buy? Support your answer with data from your survey.

4. If a men's clothing company wanted to advertise in your community, during which show should it advertise? Why?

5. If a children's toy company wanted to advertise in your community, during which show should it advertise? Why?

6. Do you think your class survey gave an accurate representation of the entire community? Please explain your answer, and describe how the data could have been more accurate.

7. Even the best-planned surveys may have flaws. For example everybody in your survey had at least one thing in common—a child in the same grade! Discuss the problems with using information gathered by a single class to describe the viewing patterns of an entire neighborhood. How might the shows watched by your families differ from those watched by families with younger children, adults without children, or senior citizens?

Detectability and Toxicity

TIME MANAGEMENT

This activity can be completed in two class periods.

MATERIALS

Strips of white paper cut to fit around a beaker
tape
index cards
lemon juice
beakers
distilled water (tap water can be substituted)
non-toxic red food coloring
Student Sheet, page 16

BACKGROUND

Sir Arthur Conan Doyle (1859-1930) entertained the world with his famous character Sherlock Holmes. Books such as *The Hound of the Baskervilles* showcased Holmes' awesome abilities of detection. In this activity, students will get a chance to do some sleuth work of their own. They will first use indicators to track the presence of a substance. Help them draw the connection between these lab indicators and those that might be measured in the "real world"—for example, particulate levels, visibility, and ozone can indicate how clean the air is in a given area.

The concepts explored in this activity—dilution, very large vs. very small quantities, indicators, and experimental bias—are crucial to students' understanding of databases. Before working with any set of data, students should understand the process by which it is gathered; have a good sense of perspective regarding very large and small numbers; and be aware that different indicators are better for gathering different types of data.

The specific concepts—toxicity, ppm, dilutions, etc.—addressed by this activity may only be appropriate for some databases. They are intended to introduce important concepts that will likely be utilized in numerous future volumes in this series.

PROCEDURE A: INDICATORS, PERCEPTION, AND MEASUREMENTS

1. Tell students they will be tracking the presence of two substances—lemon juice and red food coloring—in water. How do your students think they will be able to detect the concentration of these substances? (Color, taste, and odor are three examples.) Have students list several methods for detecting these substances, then discuss them as a class. Choose three detection methods to use later in this activity.

2. Divide students into groups of three or four. How you organize the rest of the activity is somewhat flexible, and depends upon student skill level and how much time you wish to spend on this activity. Two basic options are to have each group perform serial dilutions for both lemon juice and red food coloring, or to have half of the class work with lemon juice and the other half with food coloring.

3. Students should begin with 1 ml of lemon juice in 9 ml of distilled water. From this 10 percent solution (1 part per 10), have students progress through a standard serial dilution. As Sherlock Holmes claims in *The Sign of Four*, "Detection is, or ought to be, an exact science." Exact measurements are crucial when performing a serial dilution; remind students to label each container with both the percent of the solution, and with how many parts lemon juice each contains.

4. Students should continue the dilution until they reach a .00001 percent solution. It can be measured as 1 part per 1,000,000, or 1 ppm.

ACTIVITY SUMMARY

Students perform two serial dilutions, then use color and taste as indicators of concentration. Students then learn to define toxicity and relate toxicity to concentration.

DATABASE SKILLS

Understanding dilutions, solutes, and solvents

Understanding toxicity

Working with parts per million

Working with concentrations

Working with data indicators

Understanding very large and very small numbers

5. Have students label the strips of paper as A, B, C, etc. and tape a strip around each beaker. The beakers' original labels, which record the solution concentration, should be completely concealed.

6. Next, have students place an index card in front of each beaker. They should label each index card with the letter of the beaker with which it is paired. On each index card, they should list the three detection methods the class chose at the beginning of the activity.

7. Ask one volunteer from each group to join another group. (Because class volunteers will already know that a serial dilution process was used, a second option is to ask non-class members to act as volunteers. This method insures that the volunteers will have not know what they are detecting or how the beakers have been set up.)

8. Inform the volunteers about the three detection methods. Have these volunteers use these methods to estimate the concentration of the substance in each beaker. (Using the example detection methods from Step 1, volunteers would view, taste, and smell each beaker to estimate concentration.) They should record their guesses on the index cards.

9. When the volunteers can no longer detect the substance's presence, they should identify which solution was the last one in which they could detect the substance. This index card should be labeled:

> "Smallest concentration of
>
> ______________________
>
> *(substance)*
>
> that can be identified by
>
> ______________________."
>
> *(method of detection)*

10. (Optional) If you would like students to explore how knowledge of a substance's presence affects its detectability, ask each group to perform the previous step using their own beakers.

11. (Optional) So far, students have depended on the human senses to detect concentration. Humans can extend their senses using instruments. Have them retest the beakers for the presence of lemon juice using a pH meter. Have them first find the pH of pure lemon juice and the pH of the water they are using (with nothing added). How does the pH change with different concentrations of lemon juice? What dilution has the least detectable level?

Students can retest their beakers for the presence of red food coloring using a spectrophotometer. What dilution has the least detectable level? Does not being able to detect it mean that red coloring is not there?

12. Have each group record the data from their index cards in a single data table. Tables should show the actual concentration, the volunteer's approximation of concentration, and the smallest concentration of each substance identifiable by each detection method. (This step might be done as homework.)

13. If time permits, copy these data tables so that every student can have a copy of every groups' results. Otherwise, ask each group to take a few minutes to tell the class about their findings.

PROCEDURE B: MEASURING TOXICITY

1. When working with a database that involves chemicals, it is important not only to investigate the amount of a substance, but also the substance's toxicity. As a class, come up with a working definition of toxicity.

2. Toxicologists have developed a measurement to quantitatively convey information about toxicity. LD_{50} is the concentration at which half the population exposed to a substance dies. The lower the LD_{50}, the more toxic the substance. Toxicologists use "test conditions" when describing a chemical's LD_{50}. The test conditions include:

- ▶ What toxic substance is being tested?
- ▶ What species of test animal was used in the test?
- ▶ How was the toxic substance administered (oral, injection, skin absorption)?
- ▶ What was the test animal's body weight (in grams) in relation to the volume of toxic substance administered?
- ▶ Of the total group of test animals, what percentage succumbed to the substance?

The following is a typical statement which includes the toxicity test conditions:

> Aniline LD_{50} orally in rats:
> 250 mg/kg

3. Write this statement on the chalkboard or overhead projector, and ask students if they can identify the various test conditions expressed in this statement. Take a moment to go through the following definitions.

- "LD" refers to a single Lethal Dose.
- The subscript "50" means 50 percent of the test animals succumbed to the substance.
- "Oral" means the method by which the toxic substance was administered.
- "kg" defines a unit of test animal body weight as a function of the quantity of toxic substance administered.

4. To put toxicity in perspective, have students compare several chemicals' LD_{50} to that of sodium chloride (3000 mg/kg). (If not labeled on the container, the supplier of any laboratory chemical will be able to provide you with the chemical's toxicity.)

ANSWERS TO STUDENT SHEET

1. Answers will vary. If results varied, students should provide a thorough description of variables between different groups.

2. a. Answers will vary.

b. Answers will vary.

c. Answers will vary, but students might point out that researchers can affect data knowingly or unknowingly. Experimental bias might occur if: variables are not acknowledged; if the test conditions or procedures have many sources of error; if data are not representational; or if data that seem irrelevant or incorrect are dropped from a data set.

3. Answers will vary. However, volunteers who are aware of the substance might be more likely to detect it because they are actively "looking" for that particular substance rather than passively testing for an unknown quantity and substance.

4. The toxicity of a released substance is often more crucial than the amount released. Students might also discuss the effects of these substances on aquatic species.

Detection: Understanding Very Large and Very Small Numbers

1. Did each group get the same results? Why or why not?

2. For each of the three detection methods used, answer the following questions:

a. Which substance (lemon juice or food coloring) was detectable at lesser concentrations?

b. Using the volunteer's examinations of the beakers, was one type of indicator more accurate? Did the accuracy of the indicator depend upon the substance (for example, was visual detection more accurate for one substance than for the other substance)? Please refer to your data table as you answer this question, and provide a possible explanation for your answer.

c. An experimental bias occurs when a researcher affects his or her own results. What are some ways this might occur?

3. Would the detection levels have been different if the volunteer had known the actual concentration? Please explain.

4. Consider two hypothetical substances released into the same river. Why might 10 parts per million (ppm) of Substance A be a threat, while 10 ppm of Substance B be considered reasonable?

Comparing Measurements

TIME MANAGEMENT

This activity can be completed in one class period.

MATERIALS

objects of various mass, such as:
- pencils
- erasers
- paper clips
- folded sheets of paper

scale
two-pan balance
Student Sheet, page 19

BACKGROUND

There are two ways of comparing numbers: absolutely and relatively. As numbers increase in size, it becomes easier and more important to understand them in relative terms than in absolute terms. For example, we may know that our dog, Queenie, has a mass of 20 kg. This is an absolute measurement. If we are not sure what 20 kg feels like, we can pick up the dog and find out. Relative measurements deal with comparisons. Rather than describe Queenie as having a mass of 20 kg, a relative measurement might describe the dog as having a mass three times that of the neighbor's cat.

Which type of description is more convenient? It depends how the numbers are being used. The following activity will help students develop an understanding of the difference between absolute and relative measurements, and improve their ability to describe numbers in relation to other numbers.

PROCEDURE

1. Have students use a balance scale to determine the mass of at least six different objects.

2. They should record these data in Table 5.1 on the Student Sheet in the column labeled "Absolute Measurements." (See Sample Table 5.1 on page 18 for an example.)

3. In the real world—talking with friends, reading the newspaper, watching television—we often encounter data that are described in relative terms. It is important to identify such descriptions, so that we understand exactly what is being conveyed. An example of an relative description might be, "The river is twice as high yesterday as it was last year on the same day." In the third column of Table 5.1, have students write relative measurements for the six different objects. (See Sample Table 5.1 on page 18 for an example.)

4. Actual databases often contain data that are in the millionths as well as in the millions. One way to address such very small and very large numbers is to develop a context that is more manageable. This can be done by comparing them to familiar objects. The first step is often creating a scale. Table 5.2 on the Student Sheet provides students with several events and a scale. Ask students to fill in the last blank using the scale provided. (The question is based on geologic time; you might create a different table to coincide with your class' subject matter.)

5. (Optional) If you have the time, students might create visual depictions of Table 5.2. This project might be done as homework or as part of an assessment on scale and measurement. For example, students might:

- mark off the distances on a meter stick as if it were a timeline
- stack reams of paper on top of each other. Letting each sheet of paper represent a certain number of years, they could use arrows to denote when each event occurred.
- Use an inflatable beach ball to rep-

ACTIVITY SUMMARY

Students describe various objects using absolute and relative measurements.

DATABASE SKILLS

Drawing comparisons in absolute and relative terms

Comparing different types of data

Understanding and quantifying mass

Understanding very large and very small numbers

SAMPLE TABLE 5.1

Sample Absolute and Relative Measurements

OBJECT	ABSOLUTE	RELATIVE MEASUREMENT
1. Key	5 grams	Three times as much mass as a pencil
2. Mug	50 grams	Ten times as much mass as a 10-ml beaker
3. Paper clip	1 g	1/100th the mass of a pair of forceps

SAMPLE TABLE 5.2

a. Age when dinosaurs thrived = 100-200 million years ago = 425 km = *(example: about the distance from San Francisco to Santa Barbara.)*

b. Coldest part of the ice age = 20 thousand years ago = 60 meters = shorter than the length of a football field and roughly the height of a fifteen-story building.

c. First theoretical paper on the greenhouse effect = 100 years ago = 30 cm = a little longer than an average sheet of notebook paper.

d. Time in which 100 million more humans will live on Earth = About one year = 3 mm =about the width of the E in the word Earth.

(Adapted from *Forecasting the Future: Exploring Evidence for Global Climate Change*, by the Education Department of the Stephen Birch Aquarium-Museum. 1996. Arlington, VA: National Science Teachers Association.)

resent the Earth, and mark distances directly on the ball.

6. A second way to informally describe data are with words that are "descriptors." Examples of descriptors include half, twice, and equal to. Have students look at Table 5.3 on the Student Sheet. Ask them to write five one-sentence descriptions of the data, using these types of descriptors. One example might be: "The total capacity of the High Plains Aquifer is 2.6x10^{4} L more than its typical annual recharge."

7. Lead a class discussion about the benefits and drawbacks of absolute and relative measurements. Remind students that absolute measurements are more exact and leave less room for interpretation. Exactitude is important because a single database might be used by different people with broadly ranging experiences and methods for interpreting data.

ANSWER TO STUDENT SHEET

Potential answers to the Student Sheet charts are provided in Sample Tables 5.1 and 5.2 on the left. For Table 5.3, student descriptions should meet the requirements set out in Step 6, by writing one-sentence, informal descriptions of the information.

Comparing Measurements

TABLE 5.1

Absolute and Relative Measurements

OBJECT	ABSOLUTE MEASUREMENT	RELATIVE MEASUREMENT
1.		
2.		
3.		
4.		
5.		
6.		

TABLE 5.2

Because the average person lives fewer than 100 years, it is difficult to think about periods of time as long as 5,000,000,000 years. The table below will help place some important events in geologic time into perspective. The first step is to devise a scale. If the age of the Earth, 4.6 billion years, is compared with the diameter of Earth, 13 million meters, you have a scale you can use to come up with comparisons for the events below. Use the scale to fill in the blanks with measurements that are a bit more common than those provided. (An example is provided for the first comparison.)

a. Age when dinosaurs thrived = 100-200 million years ago = 425 km = ________________
(example: about the distance from San Francisco to Santa Barbara.)

b. Coldest part of the ice age = 20 thousand years ago = 60 meters = ________________

c. First theoretical paper on the greenhouse effect = 100 years ago = 30 cm = ________________

d. Time in which 100 million more humans will live on Earth = About one year = 3 mm = ________________

TABLE 5.3

Balance Sheet Estimates for the High Plains Aquifer

DIMENSIONS	SCIENTIFIC NOTATION	COMMON NOTATION
maximum width	5x102 km	500 km wide
maximum length	1.2x103 km	1150 km long
CAPACITY		
Total Capacity	3.9x10^{15} L	3.9 million trillion liters
Typical Annual Discharge	2.7x10^{13} L	27 thousand trillion liters
Typical Annual Recharge	1.3x10^{11} L	13 trillion liters

(Source: William Ashworth, ed. 1991. *The Encyclopedia of Environmental Sciences.* New York, NY: Facts on File.)

ACTIVITY 6

Describing Data

ACTIVITY SUMMARY

A discussion of basic statistical measurements, and how to find them, is followed by individual or group work to practice using these methods.

DATABASE SKILLS

Describing data using statistical measurements: median, mode, and average

Identifying trends in data

TEACHING NOTES

- **Graphing calculators can greatly reduce the work involved in organizing sets of numbers and calculating their central tendencies. See Appendix A, page 47, for the steps to sort numbers and calculate mean, median, and other statistics on a TI-82 calculator.**
- **Neither the median nor the mean can tell us as much about the data as a plot showing all the values, such as a number line plot, a dot plot, or a stem-and-leaf plot. Activity 7 on page 24 provides suggestions for introducing these methods to your students.**
- **Many of the statistical interpretation methods discussed in this activity are also discussed in Activity 7, pages 24-33. Activity 7 provides several advanced methods for looking at data sets, whereas this activity is a good introduction to the basic techniques. You may wish to conduct one activity by itself, or adapt the most relevant parts of both activities to fit your needs.**

TIME MANAGEMENT

This activity can be completed in one class period.

MATERIALS

Chalkboard or overhead projector
Student Sheets, pages 22-23

BACKGROUND

Databases are created to help people answer questions. (What is the pattern of stream flow in the Mississippi River? How have interest rates varied over the past 10 years?) However, the answers don't usually leap out from a set of data. The first step towards answering the larger questions is interpreting the data. Being able to describe a set of data will give you a better understanding of a set of numbers.

Averages are a common method for describing data. Two types of averages—median and mean—summarize the data by giving a measure of the center of the data values. For example, if Peter gets scores of 80, 84, 95, and 90 on five science tests, then his average is:

$$\frac{80 + 96 + 84 + 95 + 90}{5} = \frac{445}{5} = 89.$$

This way of computing an average is called the mean. Thus, the mean of Peter's scores is 89. Another type of average is the median. To find the median of Peter's test scores, first put them in order from smallest to largest:

80 84 90 96 96

The middle score, 90, is the median. Half of the test scores are lower or equal to the median; half are greater than or equal to the median. If there is an even number of scores, the median is halfway between the two scores in the middle:

25 80 84 90 96 96

The median of the above number set is 87, which is halfway between 84 and 90.

Which type of average—mean or median—you use depends on your purpose in finding a measure of center. When there are no outliers (values that are widely separated from the rest of the data), there generally will not be much difference between the median and the mean, and which method you choose won't matter much.

A third method for describing data is the mode. The mode of a set of data are the responses that occur most frequently. The mode of the number sets above, for example, is 96. Another method is the range of data, which is the difference between the smallest number and the largest number in a number set. The range of Peter's last set of scores is 71 points.

PROCEDURE

1. Distribute a copy of the Student Sheet to each student.

2. Show students how to find the mean, median, mode, and range of a set of data.

3. Divide the class into groups of three or four students, and ask them to answer the questions on the Student Sheets.

4. (Optional) Another way to teach mean, median, and mode is with a simple popcorn activity. Put out a bowl of popcorn, and have each student take three handfuls. Each student counts and records the number of pieces in each handful. They then report the number of pieces in each of their handfuls, and the class creates a combined data table on the board. As

the students eat their popcorn, discuss patterns in the data. Calculate the mean, median and mode of the handfuls. Are these numbers similar? What does this indicate about the data? If the numbers are similar, the data likely are evenly distributed, whereas if the numbers are significantly different there are some handfuls that are much bigger or smaller than most that skew the average.

ANSWERS TO STUDENT SHEET

1. $6.34

2. $5.24

3. $4.74

4. $4.77

5. The median gives a better indication of the prices, because measurements of median are not as affected by data points that are dramatically different from the rest of the data.

6. Ice cream is generally more expensive.

7. $9.35

8. $5.00

9. Characteristics may include:

a. mode—describes the most typical number

b. median—not so affected by outliers, usually lower than the mean

c. mean—somewhat affected by outliers, usually higher than the median

d. range—shows how spread out a set of data are

Describing Data

TABLE 6.1

The prices for the different kinds of ice cream and ice milk/dairy desserts sold at a Los Angeles supermarket.

ICE CREAM	PRICE FOR HALF A GALLON
Ben and Jerry's	$11.80
Breyer's	4.65
Dreyer's Grand	4.79
Frusen Gladje	10.76
Haagen Dazs	9.98
Jerseymaid	2.65
Jerseymaid Natural	2.50
Jerseymaid Old Fashioned	2.50
McConnell's	9.96
Mrs. Field's	4.69
Royal Request	9.38
Westwood	2.45

ICE MILK/DAIRY DESSERTS	PRICE FOR HALF A GALLON
Breyer's Natural Light	$4.85
Dreyer's Grand Light	4.79
Jerseymaid Lightly Maid	2.85
Jerseymaid Light	3.85
Lean Cuisine	4.75
Weight Watchers	10.36

(note: brands not sold in gallons were calculated based on what the price would be for a gallon.)

1. What is the mean price of a half gallon of ice cream?

2. What is the mean price of ice milk/dairy desserts?

3. What is the median price of a half gallon of ice cream?

4. What is the median price of ice milk/dairy desserts?

5. Which method, median or mode, gives a better indication of the typical price of ice cream? of ice milk/dairy dessert? Explain.

6. In general, which type of product is more expensive?

7. Combine both lists and find the range in prices.

8. Round each price to the nearest dollar. Using the combined list, what is the mode of the prices?

9. What are some characteristics of each of these different types of measurements?

a. mode

b. median

c. mean

d. range

Analyzing Data

ACTIVITY SUMMARY

This activity presents students with several options for analyzing sets of data. Each step introduces a new technique by posing a "Sample Question," which is then answered with a brief explanation of the technique and a teacher-led demonstration.

DATABASE SKILLS

Using the following data analysis techniques:

a. range

b. average (mean)

c. standard deviation

d. median score

e. quartiles

f. examining distribution with stem-and-leaf plots

g. examining distribution with box-and-whiskers plots

h. identifying outliers

i. establishing relationships between two variables

j. examining distribution with scatter plots

TIME MANAGEMENT

This activity can be completed in one or two class periods. To use less class time, assign the questions on the Student Sheet as homework.

MATERIALS

graphing paper
pencils
calculator
Student Sheets, pages 32-33

BACKGROUND

Calculations such as mean, median, and mode describe the center of a set of data. They are therefore called measures of central tendency. While central tendency measurements describe a set of data, dispersion measurements help complete the picture. This activity gives students several options for analyzing data using measurements of both dispersion and central tendency.

The following set of data (Table 7.1, page 25) shows the scores a class produced on two end-of-unit exams and a final exam. While the individual score is important to each student, many additional interpretations can be made by looking at the data as a set. The two most common ways to analyze these data are by finding each student's average score, and to find an average score for each exam. However, some fairly basic methods can help identify even more information from these scores.

Before beginning the activity, provide each student with a copy of the Student Sheet. Try posing the sample questions to students to see how many of them are familiar with each technique. If possible, have a student demonstrate how to perform each calculation.

As each calculation is discussed, have students record definitions, formulas, and procedures on a separate sheet of paper. They can then apply each technique (individually or in groups) by responding to the practice questions on the Student Sheet (page 32). When finished, students will have a record of several data analysis techniques which they can use when working with any number set.

PROCEDURE

1. RANGE

Sample Question: What is the range of scores for exam 1?

The range of scores includes the highest value and the lowest value in a set of data. It is also important to consider the possible range of scores when analyzing data.

Maximum = 100
Minimum = 43
Possible Maximum = 100
Possible Minimum = 0

2. AVERAGE (MEAN)

Sample Question: What is the average (mean) score of exam 1 and what is its standard deviation?

The standard deviation is a measure of how far away the scores in a set are from the average. The standard deviation is often reported as an absolute error (same units as the measurement) in a measurement.

To find average (mean):

$$\bar{X} = \text{Average} = \frac{\Sigma \bar{X}}{n} = \frac{1742}{22} = 79$$

To find standard deviation (where n = total number of data points):

$$\delta = \text{Standard Deviation} = \sqrt{\frac{\Sigma(\bar{X} - X)^2}{n-1}} = 12$$

3. MEDIAN

Sample Question: What is the median score for exam 1 and what are the quartiles?

Yet another way of showing dispersion is to show the proportion of people scoring in the various quartiles. The median and quartiles of a number set are easiest to find when the data are sorted by number value. For this set of data, the data could be sorted by score rather than by name. The median score is the center score. Each half of the data can be split in half to find the upper and lower quartiles.

100, 93, 91, 91, 90, 88, 88, 87, 85, 83, 82,|78, 76, 76, 76, 75, 74, 74, 73, 68, 55, 43
median

median = $\frac{82 + 78}{2}$ upper quartile = 88 lower quartile = 74

4. DISTRIBUTION PLOTS (STEM-AND-LEAF, BOX-AND-WHISKERS)

Sample Question: How are the scores on exam 1 distributed?

There are two effective techniques for examining the distribution of a data set. The first is a stem-and-leaf plot. To create a stem-and-leaf plot, the first step is to identify the possible range of values. For the exam, the possible scores are from 0 to 100. The first digits of a number are the stem, and the last digit, no matter what decimal place, is the leaf.

The following examples show data from Table 7.1.

The possible stems are first placed on an axis like this:

0 |
1 |
2 |
3 |
4 |
5 |
6 |
7 |
8 |
9 |
10 |

TABLE 7.1

Class 1

NAME	SCORE EXAM 1	SCORE EXAM 2	SCORE FINAL EXAM
John	93	88	90
Mary	74	90	78
Sally	43	70	62
Tisha	88	84	88
Albert	76	68	72
Anton	68	55	45
Anna	100	91	95
James	87	86	86
Sue	76	89	88
Daniel	55	72	70
Lisa	90	89	92
Jennifer	91	90	89
Sophe	74	86	80
Susan	78	77	77
Kevin	83	84	90
Peter	76	45	62
Ben	75	76	80
Stacey	82	81	83
Wesley	72	77	76
Carlene	91	88	91
Jessica	88	72	72
Amy	85	80	81

EMPHASIS ON THE MEDIAN

You may have noticed that this book focuses more on median than on mode. There are two main reasons for this emphasis. First, the median is a simpler idea, requiring students to perform less computation. Second, the median is not affected by a few extremely large or small values (as is the mean).

The mode is generally not useful for interpreting and summarizing data. One reason is that many sets of data, such as 22, 25, 28, and 29, have no mode. In contrast, median and mean are always defined. Second, the mode is unstable. For example, the mode of 1,1,3,5,8, and 9 is 1. However, by slightly changing two values—to 1,2,3,5,9, and 9—the mode becomes 9. Finally, as shown in the last example, the mode does not necessarily indicate the center of the data. For these reasons, statisticians tend to use median-based statistics when analyzing data.

The next step is to add the leaves, which are the last digits of a number.

0	
1	
2	
3	
4	3
5	5
6	8
7	4 6 7 4 8 6 5 3
8	8 7 3 2 8 5
9	3 5 0 1 1
10	0

The final step is to arrange the leaves in order, numerically. If you previously sorted the data, this step may be already done. The final stem-and-leaf plot looks like this:

0	
1	
2	
3	
4	3
5	5
6	8
7	3 4 4 5 6 6 6 8
8	2 3 5 7 8 8
9	0 1 1 3 5
10	0

Types of Plot Distributions

There are four major types of distributions shown on stem-and-leaf plots: J-shaped, bell-shaped, U-shaped, and rectangular. Tables 7.2 to 7.5 show examples of these distribution types (they do not refer to specific data).

TABLE 7.2

A J-shaped leaf plot

0	0 1 1 2 4 6 7
1	1 3 3 4 5
2	2 4 6
3	2 8
4	0
5	1

TABLE 7.3

A bell-shaped leaf plot

0	1 2
1	4 6 7
2	0 0 1 4 5 8
3	1 1 3 6
4	2 8
5	1

TABLE 7.4

A U-shaped leaf plot

0	0 0 1 3 5 8
1	0 1 6 9
2	4 7
3	6
4	0 0 4
5	1 1 3 3 9 6

TABLE 7.5

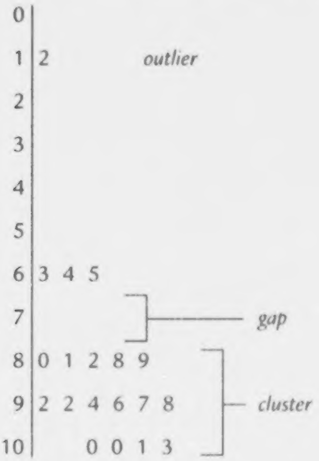
A rectangular leaf plot

0	0 1 1 3 6
1	2 4 9 8
2	2 2 6 5 4
3	4 5 5 8 8
4	2 6 7 7
5	4 4 5 6 6

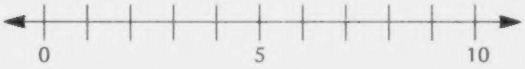
THE EVOLUTION OF MAKING PLOTS

Many of the plotting techniques taught in this activity—such as stem-and-leaf plots, box plots, and fitting a line—were developed during the 1960s and 1970s. They are so new that their names have not been universally agreed upon: fitted lines, for example, are also called Tukey lines, median-fit lines, resistant lines, and robust lines. The techniques themselves are not even set in stone. For example, some people make box plots horizontally; some make them vertically. Some people put a dent in their box plot at the median; others draw a line across the box at the median. Students like to be told that the techniques of making these plots are still evolving. They might be the ones to invent a better technique. Encourage experimentation. Because there is no "correct" way to make these plots, there's no reason to get caught up in the technicalities of making plots exactly the way this book does.

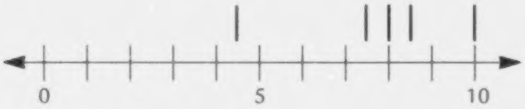
Stem-and-leaf plots also clearly show clusters, gaps, and outliers in the data.



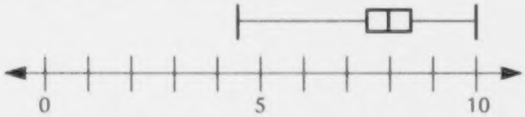
The second type of graphical description of a data set is the box-and-whiskers plot. For the box-and-whiskers plot, the first step is to draw an axis with the range of data like this:



Then the median value, upper and lower quartiles, and maximum and minimum values are placed on the plot:



The finished plot looks like this:



Each section of a box-and-whiskers plot represents 25 percent of the values examined. This method makes it easy to determine if the numbers are evenly or unevenly distributed.

5. OUTLIERS

Sample Question: What are the outliers for a set of data?

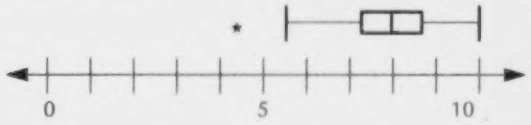
Outliers, points which lie a long way from the bulk of the data, are easy to identify on box-and-whiskers plots. If either the high whisker or the low whisker is much longer than the range of data in the center, one should check for outlier points.

The interquartile range is the upper quartile minus the lower quartile. If any point is more than 1.5 times the interquartile range above the upper quartile, or below the lower quartile, that point may be considered an outlier. Usually the whisker is ended at the next lower point and the outlier marked with a point.

Interquartile range (IQR) = 88 - 74 = 14

14 x 1.5 = 21

Therefore, any point > 88 + 21 or any point < 74 - 21 can be considered an outlier. On exam 1 the point 43 can be considered an outlier.



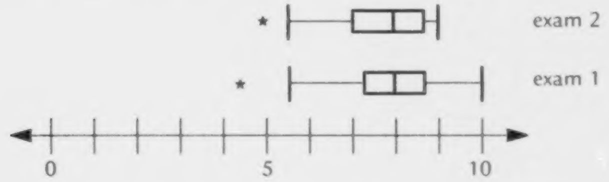
6. COMPARING SETS OF DATA

Sample Question: Is there any difference in the class performance on exam 1 and exam 2?

This question compares two sets of data. The most effective methods for this comparison are back-to-back, stem-and-leaf plots, or stacked box-and-whiskers plots. A back-to-back, stem-and-leaf plot looks like:

	0	
	1	
	2	
	3	
3	4	5
5	5	5
8	6	8
8 6 6 6 5 4 4 3	7	0 2 2 6 7 7
8 8 7 5 3 2	8	0 1 4 4 6 6 8 8 9 9
5 3 1 1 0 9 0	0	1
0	10	

Stacked box-and-whiskers plots look like:



7. RELATIONSHIPS BETWEEN TWO VARIABLES

Sample Question: Is there any relationship between student performance on exam 1 and the final exam?

This question seeks to establish a relationships between two variables. The first step is to create a scatter plot. The scores for each student are graphed with exam 1 as the independent variable and the final exam as the dependent variable. Tables 7.6 and 7.7 on page 30 shows a scatter plot of these data.

The scatter plot can be described as having a positive association, a negative association, or no association. Tables 7.8, 7.9, and 7.10 on page 31 show these types of associations.

NOTE: Several advanced techniques for curve fitting are discussed in Appendix B on page 48, and Appendix C on page 50. These techniques require the use of a graphing calculator or data analysis program on a computer.

ANSWERS TO STUDENT SHEET

Answers should follow formats taught in the Teacher Section's Sample Questions.

TABLE 7.6

Scatter Plot

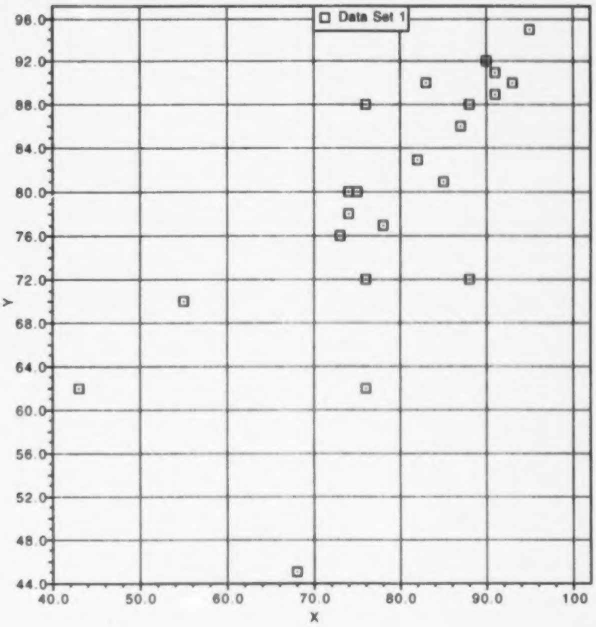


TABLE 7.7

Scatter Plot with Best Fit Line

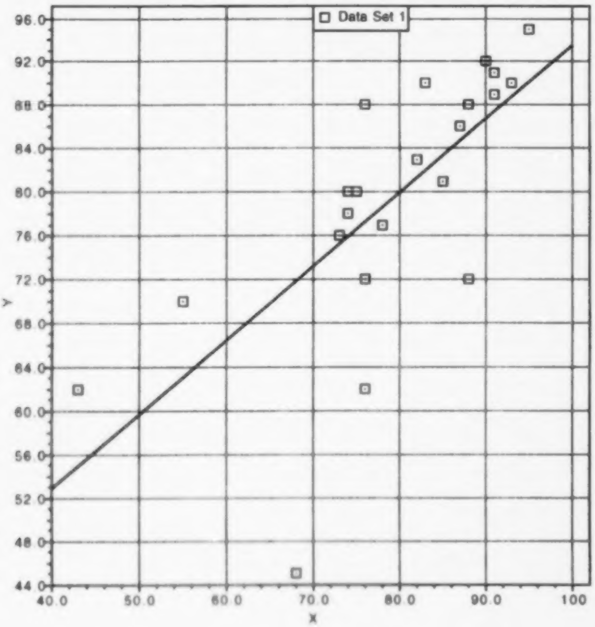


TABLE 7.8

Positive Association

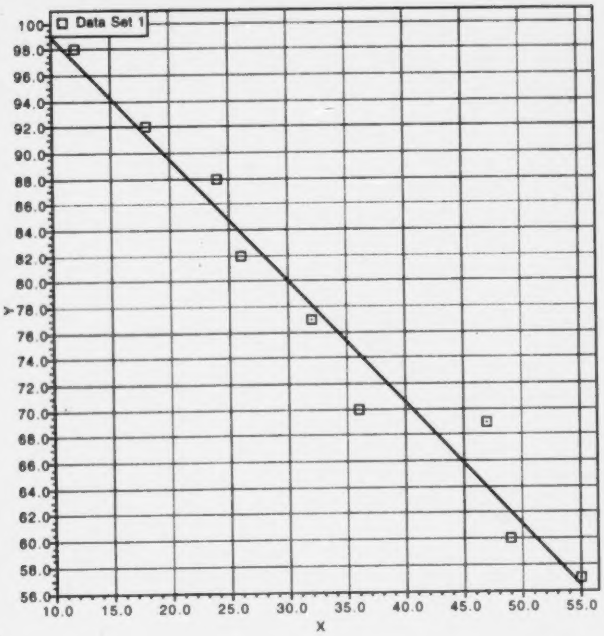


TABLE 7.10

No Association

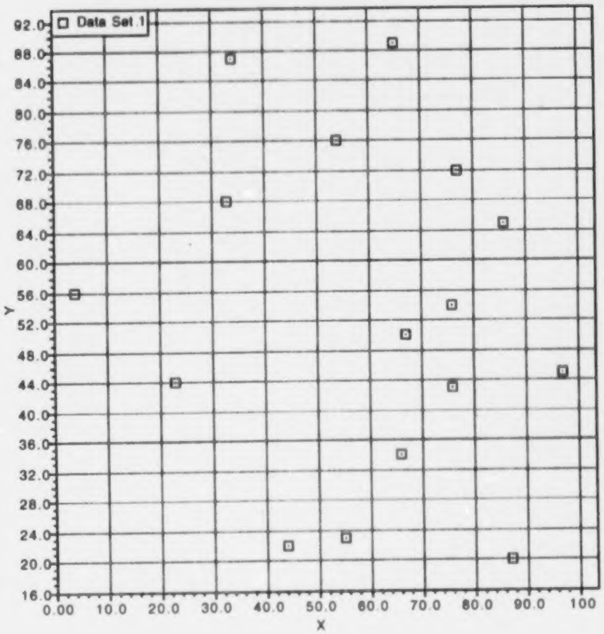
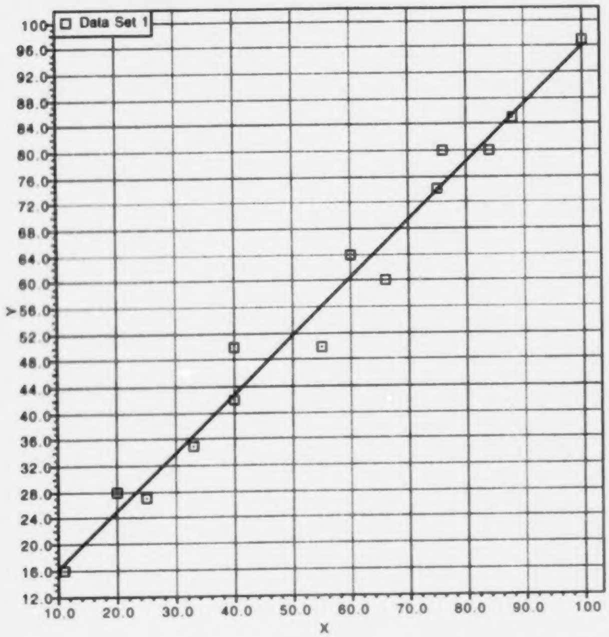


TABLE 7.9

Negative Association



Analyzing Data

1. RANGE

Sample Question: What is the range of scores for exam 1?

Practice Questions:

a. What is the range of scores for exam 2?

b. What is the range of scores for the final exam?

2. AVERAGE (MEAN)

Sample Question: What is the average (mean) score of exam 1 and what is its standard deviation?

Practice Question:

What is the average score of exam 2 and its standard deviation?

3. MEDIAN

Sample Question: What is the median score for exam 1 and what are the quartiles?

Practice Question:

What are the median score and the quartiles for exam 2?

4. DISTRIBUTION PLOTS (STEM-AND-LEAF, BOX-AND-WHISKERS)

Sample Question: How are the scores on exam 1 distributed?

Practice Questions:

a. Use a separate sheet of paper to draw a stem-and-leaf plot for exam 2.

b. Use a separate sheet of paper to draw a box-and-whiskers plot for exam 2.

5. OUTLIERS

Sample Question: What are the outliers for this set of data?

Practice Questions

a. Find the outliers for exam 2.

b. On a separate sheet of paper, draw a revised box-and-whiskers plot, with the whisker ended at the next lower point and the outlier marked with a point.

6. COMPARING TWO SETS OF DATA

Sample Question: Is there any difference in the class performance on exam 1 and exam 2?

Practice Questions:

a. Describe the difference between the class' performances on exam 1, exam 2, and the final exam.

b. Describe the difference in the performance of males and females on exam 1.

7. RELATIONSHIPS BETWEEN TWO VARIABLES

Sample Question: Is there any relationship between student performance on exam 1 and the final exam?

Practice Question:

Is there any relationship between student performance on exam 2 and the final exam?

ACTIVITY 8

Displaying Data with Graphics

ACTIVITY SUMMARY

Students examine the way published data are presented graphically to guide their own work in presenting data.

DATABASE SKILLS

Identifying appropriate methods to graphically display data

Communicating scientific research

Explaining data using graphics

TEACHING TIPS

- **If students are unable to locate every type of data graphic they originally listed, suggest they create their own examples based on real data.**
- **An alternative procedure is to assign student groups to a particular category of graphic. The group would then provide examples in that category and develop that section of the class portfolio.**

TIME MANAGEMENT

One class period to introduce and discuss the activity.

One week for out-of-class research.

One day for students to discuss the graphical methods they have researched.

MATERIALS

Pre-Activity Tables, page 37
Data Graphics Guidelines, page 36
Optional materials might include:

- computer on which students can design graphs and tables
- graph paper
- cardboard
- markers

BACKGROUND

Working with statistics and presenting their results provides a good opportunity to increase students' communications abilities. In fact, communicating one's work is a crucial part of any scientific endeavor. This activity focuses on graphically communicating data and statistical information.

According to one graphic designer, "...of all methods for analyzing and communicating statistical information, well-designed data graphics are usually the simplest and at the same time the most powerful." (Source: Tufte, Edward E. 1983. *The Visual Display of Quantitative Information.* Cheshire, Connecticut: Graphics Press.) Modern graphics play a large part in communicating any set of information. In fact, data graphics do a lot more than substitute for tables—they are often the most effective way to describe, explore, and summarize data.

Encourage students to discuss how graphics might have supplemented reports they have written for science classes. The addition of well-designed data graphics to clearly-written text can make all the difference for scientists trying to communicate research to their colleagues—or for students handing in a term paper.

Charts, timelines, histograms, and tables are just a few ways to present information. In this activity, students will explore types of data graphics, using a standard format that will allow their collected work to be used as a class portfolio. They will be able to use this portfolio as a reference for conveying data they generate or collect throughout the semester.

PRE-ACTIVITY

1. Distribute copies of Tables 8.1 and 8.2 on page 37.

2. Tell students that the lower two lines on Table 8.2 show precisely the same information as the two lines in Table 8.1. Have students compare these two tables.

3. What differences can students identify in these two graphs? Talking points include:

a. Table 8.2 shows the combined score in addition to the individual trends.

b. To show the combined scores, the Table 8.1 plots data on a 600-point scale that runs from 200 to 800. Table 8.2 shows the SAT score decline plotted on a 100-point scale running from 400 to 500 points.

c. The graph in Table 8.1 might lead people to use words like "plunge" and "plummet." The graph in Table 8.2 looks much less dire.

d. Graphs with more restricted parts of the scale represent a common and often unintentional way of misleading people with a data graphic.

e. It is important to examine graphs to make certain that the scale is properly represented and that the data actually say what is claimed for them.

PROCEDURE

1. Bring several copies of *USA Today* into class. Give each student a different section of the newspaper. Ask them to discuss how the paper displays information—are the graphics interesting? How much information do these graphics present? What is the purpose of these graphics? What is the audience looking for in these graphics?

2. Ask the class to generate a list of techniques used in the paper that might be useful when working with scientific data. Have a volunteer write this list on the chalkboard or overhead projector.

3. When students have finished identifying the newspaper's various data graphics, ask them to look at their list. Can they think of other data graphic styles that might be useful for presenting data? Is there data that students are familiar with that can't be easily presented by the methods they've just reviewed?

4. For homework, have students collect data graphics from other printed or on-line (and printable) materials. Ask students to find examples of different types of data graphics. Sources of graphics include:

- newspapers
- brochures
- scientific and other journals
- almanacs
- textbooks

5. Once students have gathered their data graphics, they should paste or print each graphic onto the top of a blank sheet of paper. Below the graphic, they should write a brief description of each data graphic and explain the data that method is illustrating. Is it a pie chart? A timeline? Does it show one variable? Two variables?

6. After students have collected their examples of data graphics and defined them, assemble the students into groups of three or four to further analyze and critique the data graphics. Hand out the Data Graphics Guidelines Sheet on page 36 to guide their critique.

7. Below their data graphic descriptions, students should record their group's critique. (Students may want to take notes on the group discussion, then rewrite them onto the bottom of the graphic sheet once the discussion is complete.) What is the purpose and quality of the graphic? Are there advantages to using that type of graphic with that data set? Are there disadvantages? How would they improve on the graphic? You may wish to have each group nominate a best and worst graphic for class discussion.

NOTE: The procedure uses *USA Today* because of its particular strength in using data graphics. Other newspapers, journals, or technical books might be used as substitutes.

Data Graphics Guidelines Sheet

Graphics are intended to reveal data, to make them more accessible to your eye and mind than raw numbers. Graphics put complex ideas into a format that is comfortable to look at, and therefore comfortable to understand. Data graphics can also distort the perception of the data. Sometimes this distortion is on purpose; sometimes the graphics are just poorly done.

Data graphics can be designed for a specific audience, or for a broad audience. Consider the audience for which the data graphics you collected were designed. To entertain a general newspaper readership? To show elementary school students a relationship between hours of sunlight and growth of bean plants?

Data graphics can also be designed for a specific purpose. Are the data being presented to support an economics news analysis? To show the interaction of several weather variables? Graphics should reflect, in both tone and content, the purpose for which they were created. They may be descriptive, they may be decorative, they may encourage exploration of a concept behind the data.

GUIDELINES FOR THE PRESENTATION OF DATA IN GRAPHICAL FORM

A successful data graphic

- shows the data
- labels the variables and the scales on which they are presented
- guides the eye so the reader can compare different pieces of data
- presents many numbers in a small space
- provides ways to look at several layers of detail, from an overview of the data to the data's fine structure
- does not distort the meaning of the data
- induces the reader to think about the substance of the data rather than about the graphic design or the design technology

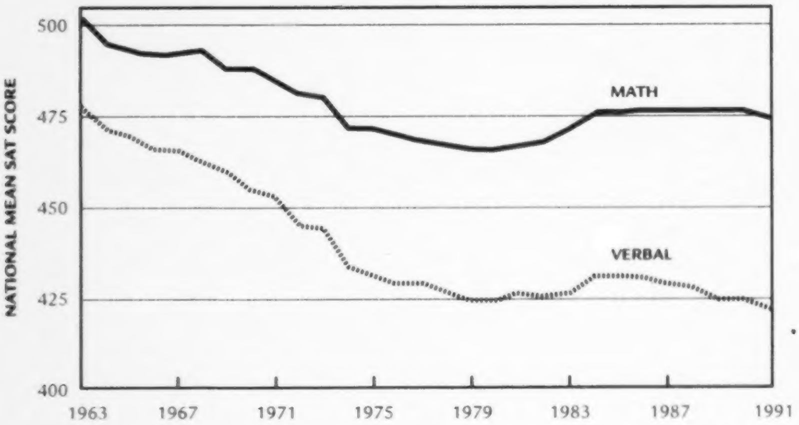
An unsuccessful data graphic

- does not label the variables or their scales
- distorts the relationships among data through faulty use of perspective or "artistic" license
- connects data points with lines that have no meaning
- distorts the relationships among data by falsely implying relationships, e.g. showing incidence of some event by county on a map, when geography has nothing to do with the events
- shows relationships or causes that do not exist, e.g. the amount of solar radiation compared with the prices on the New York Stock Exchange
- neglects to show all the data
- uses so much color or decoration that the data are obscured

Pre-Activity Tables

TABLE 8.1

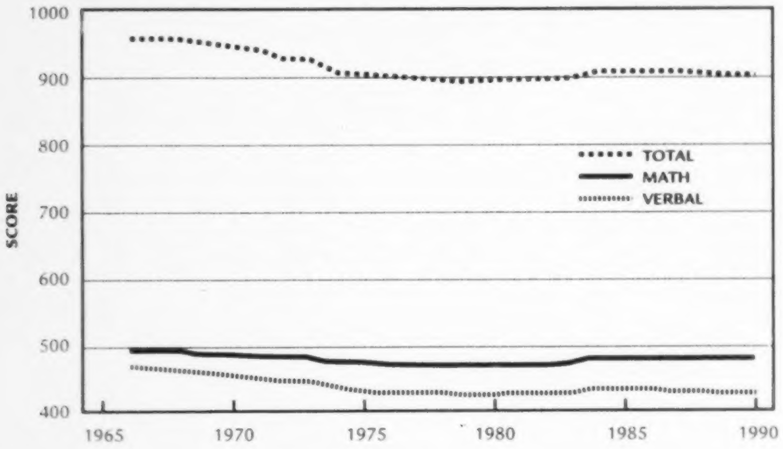
Decline in SAT Scores, Graphed on a 100-Point Axis



(Source: Charles Murray and R.J. Herrnstein. 1992. "What's Really Behind the SAT-Score Decline?" *The Public Interest* No. 106 (Winter 1992), p. 33.)

TABLE 8.2

Decline in SAT Scores, Graphed on a 600-Point Axis



(Source: C.C. Carson, R.M. Huelskamp, and T.D. Woodall. 1992. *Perspectives on Education in America.* Albuquerque, NM: Strategic Studies Center, Sandia National Laboratories, p. 39.)

Using Statistics to Persuade

ACTIVITY SUMMARY

Students research data on an athlete, then use statistics to justify their athlete is the "Most Valuable Athlete."

DATABASE SKILLS

Identifying and researching the most relevant data

Preparing statistical summaries from a set of data

Understanding how statistics can be used for multiple purposes

Using statistics to present an argument

Making oral presentations based on database information

TIME MANAGEMENT

One class period to introduce the activity and concepts.

One week (out of class) for research and presentation preparation.

One class period for student presentations.

MATERIALS

Student Sheet, page 40

Optional materials might include:

- computer on which students can design graphs and tables
- graph paper
- cardboard
- markers
- daily newspaper with sports pages
- sports almanacs (see Potential Resources sidebar on page 39.)

BACKGROUND

Even if you don't read the newspaper sports pages every morning, you've probably heard people arguing that their home team is having its strongest season ever, or that a certain player's career seems to be on the upswing. People talking about sports often use statistics to help prove their argument. Examples of sports statistics include batting averages, horse racing odds, and pass attempts vs. pass completions. Any way you look at it, statistics are an integral component of sports.

Because these same techniques can be used for discussions about nearly everything, it's important to be able to feel comfortable using statistics. This activity will help students learn how to stress different numbers to make different points. They will even learn to make contrasting arguments using the same data. As your class will discover, a successful argument has a lot to do with how the data are presented. Before students prepare their arguments, discuss various methods for using the same data to present different sides of an argument.

PROVIDING ALL THE INFORMATION

One way to present different sides of an argument is to leave out pertinent information. And stressing different numbers can present a very different picture of the same set of data. Presenting the complement of a fact is a similar technique. For example, rather than say that a player got a hit at 33 percent of his "at bats" (a very good average in baseball), report that he was "out" 67 percent of the time.

RANK VS. PERFORMANCE

A fair representation of a study shows all pertinent data. But the fairest representations also show actual performance. Remind students to always keep in mind that ranks obscure performance. For example, in the Atlanta Olympic's 200-meter dash, Michael Marsh of Houston came in last. But his performance (his actual running time) still left him the 8th fastest man in the world at 200 meters. And if he had improved his performance by a mere 7 percent, he would have gotten the gold. Another example: Among people who have hit over 700 home runs, Babe Ruth ranks dead last. Keep rank vs. performance in mind when describing data.

RATES VS. NUMBERS

It is equally important to be aware of whether you are dealing with rates or numbers. For example, until 1997, black students dropped out of school at a higher rate than white students, and Hispanic students had a much higher dropout rate than either of the two other groups. However, the typical dropout is a white, male suburbanite, because whites make up almost 70 percent of the K-12 population. Their dropout rates are lower, but their dropout numbers are higher.

The Hispanic dropout rate provides a good example of how a single statistic can mask important information. Hispanic students originally from other countries drop out at about three times the rate of Hispanic students born in the United States. For that matter, the Hispanic dropout rate varies immensely by country of origin. To address the "high dropout rate among Hispanic students," one would need to know more than just the "Hispanic dropout rate."

Because this activity leaves much room for independent research and decisions, it might be used as a final assessment of students' mastery of statistics. When all the students have had a chance to nominate their athlete, have the class vote for "Most Valuable Athlete."

PROCEDURE

1. Provide the class with several sports almanacs which cover the same season or seasons. (Some useful sports almanacs are listed under "Potential Resources" at right.) You may wish to assign the sport that will be followed, or take a class vote to increase student ownership of this activity. If you have access to statistics for your school's athletics teams, you may want to use these data instead. Another option is to have students research sports legends, such as Babe Ruth or Joe Namath; this method would teach students to compare very different data sets.

2. Have each student select a different athlete to research.

3. Ask students to use the statistics provided in these almanacs to prove that their athlete should be the "Most Valuable Athlete." Explain that they will be asked to argue their athlete's merits based on statistics. Over the course of the next few days, students should use these almanacs to research their athlete's performance. Students following a baseball player, for example, would track hits, runs, on-base percentages, and errors.

4. Students should also learn about other athletes chosen in class so they can make comparisons.

5. To help make their argument, students should provide their data in multiple formats—for example, in addition to verbally discussing their athlete's strengths, students might use charts, tables, and histograms.

6. Devote a class period for presentations of students' data analyses. Give each student a chance to nominate their player for "Most Valuable Athlete," and to defend his or her choice.

7. (Optional) Using the data from this activity, have the class create "advertisements" promoting each athlete's strengths. Students can present their advertisements to the class and explain how and why they emphasized and de-emphasized particular data. In addition to improving students' communication skills, this optional step provides an opportunity for assessing their understanding and facility with these skills.

8. You might assign the Student Sheet on page 40 as homework, or use it as the basis for assessment.

ANSWERS TO STUDENT SHEET

Answers will vary, but should display a clear understanding of how statistics can be used to support arguments. Students should be able to refer to their research and class presentations when answering these questions.

POTENTIAL RESOURCES

School and local libraries contain a variety of almanacs which will contain data for this activity. Examples of sports almanacs include:

Mass Market Paperback, ed. 1996. *1996 Baseball Almanac.* New York, NY: Signet.

Marty Strasen. 1996. *1996–1997 Basketball Almanac.* New York, NY: Signet.

Hughes, M., *et. al.* 1996. *1996–1997 Hockey Almanac.* New American Library.

Hassan, John, ed. 1997. *The 1998 ESPN Information Please Sports Almanac.* New York, NY: Warner Books.

NOTE: The Activity 8 pre-activity, on misleading data graphics, might also be used before conducting this activity.

Using Statistics to Persuade

After hearing all the nominations, answer the following questions on a separate sheet of paper.

1. Write a few paragraphs discussing how different methods of presentation have different benefits.

2. It's important to understand how statistics can be used to prove opposite sides of an argument. Write two paragraphs: one supporting your athlete, the other against your athlete.

4. How did you select the statistics for your presentation?

5. How did you use those statistics to prove a point?

6. When working with databases, you will occasionally need to make predictions. To do this, you will have to look for patterns in past data. Using data discussed during class, project which athlete will be most successful during the following season.

The Steps of Decision Making

TIME MANAGEMENT

One to two class periods to complete the decision charts. (Students might need to perform research outside the classroom between these two periods.)

One class period to make a final decision and discuss the process.

MATERIALS

Student Sheets, pages 43-45
Blank Decision Chart, page 46

BACKGROUND

This activity introduces decision analysis, a method through which students can organize information in order to reach a decision. This method can be applied to almost any problem, whether the decision is personal or part of a class discussion on a particular science subject.

Databases are ideal tools for making decisions. It's a two-way process: skills learned through decision analysis can also help students gauge the importance of different data sets. A good decision maker, however, can assess hard data along with intangible factors when making decisions. Intangible factors may include ethical concerns, economic aspects, and public attitudes or perceptions. Decision analysis gives students a way to compare both data and perception as separate—yet important—factors in the decision-making process.

For students who learn the logic of decision making, studies reported in the news, labs they conduct in class, symbols, and vocabulary words are no longer disconnected pieces but, when combined, comprise the entirety of the scientific process.

PROCEDURE

1. In this activity, students will use a decision chart to decide whether to raise the speed limit. The decision chart on the Student Sheet has been prepared in advance for this particular activity. The format is flexible; more columns and rows can be added depending on your needs.

2. Give each student a copy of the Student Sheets, pages 43-45. Have a volunteer read the scenario (page 44) aloud.

3. Now take a few minutes to have students brainstorm. What goals would they like to achieve? Examples include: increase revenue, reduce traffic fatalities, appease various special-interest groups, etc. Have students list about five or six goals.

4. Some goals are not as important as others. "Appeasing special interest groups" may not be quite as important as "Reducing traffic fatalities." Taking importance into account can be an effective way to organize your thoughts and simplify your decision. Ask students (on their own, rather than as a class) to rank the goals in terms of importance.

5. Have students write these goals in their decision chart according to how they rated their importance. The more important the goal, the higher it should go in the chart. Table 10.1, page 42, provides a sample chart to which you can refer while explaining these steps and how to fit them into the chart.

6. Now what options are available to accomplish your goals? Have students write their options across the top of their decision chart. (Two probable options for this scenario are: raise the speed limit to 65 mph, or keep the speed limit at 55 mph. If your students would like to add additional options, they can list them in the extra columns provided.)

7. The next step is to determine the outcomes of each option. Under each

ACTIVITY SUMMARY

Students create a "decision chart," a decision-analysis method which organizes multiple variables.

DATABASE SKILLS

Using a scientific organization method to reach a logical decision

Learning how to weigh data when forming a decision

Identifying gaps in information

Making decisions without complete data

Understanding how public perception of risk may affect a decision

TEACHING TIPS

- **Before beginning a database unit, you might pose a question to students that relates to a particular set of information. Have them write a paragraph on their initial decision. At the end of the unit, repeat the same question. At this point, students should be able develop a decision chart using information gleaned from the database, their own lab investigations, and/or further research. Their revised paragraphs should reflect their ability to draw upon all these factors in order to reach a final decision.**
- **The Blank Decision Chart, page 46, can be reproduced to use in conjunction with future activities.**
- **Further information about decision analysis is provided in *Decisions, Based on Science.* See the Bibliography and Resources section in Appendix E, page 52, for more information.**

TABLE 10.1

Sample Decision Chart

	OPTION 1: Raise speed limit	OPTION 2: Don't raise speed limit
Goal: Reduce accidents and fatalities	*Accidents that occur are likely to be more severe; Police could be freed from speed traps to concentrate on reducing drunk driving.*	*Town will lose ticket revenues; Accidents contribute business to local car repair shops.*
Goal: Reduce costs to town	*Costs may increase if accidents increase, but it is not clear that they will.*	*Costly accidents may still occur for other reasons; Police will be needed to enforce speed limit which takes them from other policing duties.*
Goal: Reduce emissions	*Emissions are higher at increased speeds, but many drivers are already driving at the higher speed.*	*If the lower speed limit is strictly enforced, emissions will be slightly lower.*
Goal: Increase town revenues	*Town will lose ticket revenues; Accidents contribute business to local car repair shops.*	*Speeding tickets generate a lot of town revenue.*

option, have students write a brief description of how the options would meet each goal. Write these outcomes in the chart's remaining boxes (two outcomes have been provided as an example.)

Students should be as specific as possible; use facts, figures, and numbers wherever possible. If there are several ways an option will affect a particular goal, they should neatly list each result within that outcome box. Many of the outcomes are discussed in the Background section (page 44) of the Student Sheet. If students are unsure about any outcome, they should leave that box blank.

8. When students have filled in all the outcomes of which they are fairly certain, give them time to research the outcomes they have questions about. Sources of information include your school library (encyclopedias, *Facts on File*, and the *Reader's Guide to Periodical Literature* might be especially useful), the Internet, back issues of the newspaper, or groups devoted to that particular subject. Students may need several days to complete this research. Remind students that decision makers rarely have all the information they'd like to have; if they can not find information for several outcome boxes, they should just use their best guess.

9. When you make a decision, you consider which goals are most important, and which results will help you meet those goals. Yet not all results are "sure things." Have students think about how much confidence they have in each of the outcomes that they listed. With 10 representing "very probable" and 1 representing "not probable," have them record their confidence levels in each outcome box. Remind students that few outcomes are as certain as people might wish them to be.

10. We say that two options have the same expected value if the choices are likely to lead to equally good results. The expected value of an outcome is the probability (P) it will happen multiplied by the value (V) of the option. (Expected Value = P x V.) Have students calculate the expected value of each option, then compare them.

11. Now have students make their decision. They've listed their goals by order of importance; they've selected the options (actions) that have to be taken to achieve their goals; they've noted the probability that each goal will be reached by each option. The option that best achieves the most important goals is the decision they choose.

12. After completing the activity, ask students if they feel their final decision is one they would really make. If not, have them examine the thinking that went into their decision. Have they missed any important goals in their analysis? Do they think any facts or estimates they used to set the importance of their goals might be flawed? Add these new ideas, then see if the decision changes as a result.

This cyclic method of reconsidering is central to making decisions. It enables students to logically examine their thinking—and will encourage them to notice that they can provide reasons for what they may have thought were "feelings," or "just a reaction." One purpose of decision analysis is to enable people to recognize inconsistencies—and consistencies—in their thinking and planning.

ANSWERS TO STUDENT SHEET

N/A

The Steps of Decision Making

A decision resolves a divergence of paths; each path will have benefits and risks. A good decision maker identifies each path's benefits and risks, uses evidence to weight them logically, and then decides. The terms used in this activity are: decision (divergence of paths), options (each path), and outcomes (a path's benefits and risks; how the choice of each option will affect each outcome). There are several decision-making techniques, but decision-making processes generally follow four steps.

STEP ONE
What's the Decision?

A. Before you do any analysis, make a tentative decision and record it.

B. Determine whose decision it is to make. Determine at what level (personal, local, national, international) the decision is being made, and make sure all goals and options are stated at this level.

C. Make a list of goals for the decision.

STEP TWO
What Should Happen?

A. In the goals boxes of the Blank Decision Chart, write the three main goals from the Step One goals list.

B. Deliberate on and select two to three options. Write those options in the options boxes of the Decision Chart.

C. How will selecting those options affect the goals? Enter obvious or initial guesses in the outcomes boxes in the Decision Chart.

D. Identify initial research needs from outcome boxes that are missing information.

STEP THREE
What Do We Know?

A. Research outcomes.

B. Complete Decision Chart with information from research.

STEP FOUR
What's the Answer?

A. Assign numerical probability estimates for each outcome in the chart.

B. Assign numerical importance levels for each goal in the chart.

C. We say that two options have the same expected value if the choices are likely to lead to equally good results. The expected value of an outcome is the probability (P) it will happen multiplied by the value (V) of the option. Calculate the expected value of each option.

D. Select which option is most likely to meet the most important goals.

The Steps of Decision Making

Background Information

SCENARIO

You are a member of the town council of your suburban town. A certain busy stretch of road in town carries about 6,000 cars per day. The road runs through a business area of the town. Some citizens would like the speed limit raised because they say it's too low for road conditions. Your popularity might increase if you raised the speed limit. But another group of citizens wants even more traffic controls to control drunk and reckless driving.

The current speed limit is 30 mph. The actual speed traveled by most cars on this two-lane road is 45 mph. About 12 speeding tickets are issued per day on that stretch of road. The average cost of the ticket is $75.00. The accidents tend to occur when people are slowing and turning into businesses along the road. Drunk drivers also cause accidents, especially at night.

As a member of the town council, you must decide whether to change the speed limit on this section of road. Your traffic administrator has given you some facts about national traffic safety. Read the background, then make a decision.

EFFECTIVENESS OF SPEED LIMITS

According to the National Highway Traffic Safety Administration (NHTSA), 77 percent of fatal accidents occur on two lane roads. And 88 percent of speeding related fatalities occur on roads that were not interstate highways. The effectiveness of speed limits to control traffic speed is somewhat debatable because several studies contradict each other. A federal study completed in June 1996, "Effects of Raising and Lowering Speed Limits on Selected Roadway Sections," indicated that most vehicles travel at the same speed along a given stretch of road—and that speed has little to do with the posted speed limit. The speed at which most cars travel is related to driver perception of a prudent speed to travel. When speed limits are raised, drivers do not significantly speed up. There was no evidence that lowering the speed limit reduced the accident rate or that raising the speed limit increased the occurrence of accidents.

Other studies, based on recent increases in state speed limits on interstates, have been mixed. In some state studies, the average speed did increase when speed limits were raised. According to these studies, people seem to pick a speed slightly higher than the speed limit no matter how fast the limit. But in other studies, the average speed on interstates did not significantly increase when the speed limit was changed to any "reasonable and prudent" speed.

SAFETY AND SPEED LIMITS

Reducing injuries and deaths in crashes is an important goal. Although actual numbers of fatalities change from year to year, comparisons of fatalities per vehicle miles traveled are the lowest in the history of the automobile. Although our society travels more miles per year by motor vehicle, we are less likely to die per mile traveled. Some reasons for the low fatality rate per mile traveled are improvements in car and road design, improved vehicle safety features, and more control over drunk driving.

Speed is an important factor in injury prevention because the higher the speed the more severe the crash. NHTSA cites "speed-related factors" as contributing to one-third of all crashes. Other causes include drinking alcohol, driving too fast for road conditions, failing to yield, and careless driving. However, even if the speed limit is 55 mph on a certain road, on wet days a prudent driver would reduce speed. Therefore, posted speed limits are not the only factors in speed-related accidents.

COSTS OF ACCIDENTS

The costs of crashes can be categorized as: property damage, productivity loss, medical, insurance administration, legal, funeral, and emergency service costs. The most costly crashes to society are those in which someone is injured or killed. But the most common crashes are property damage only (86 percent of all crashes).

Alcohol-involved crashes tend to be more severe and cause up to 30 percent of all crash costs. Exceeding the speed limit or driving too fast for conditions were also big factors in costs. However, as noted above, driving too fast for conditions is not necessarily related to the speed limit.

Using safety devices reduces the cost of accidents because they reduce injuries. Used properly, seat belts and airbags do reduce the overall injury and death rate in accidents. Again, these are less effective at high speeds.

Although accidents can be tragic and cost money to society, they contribute income to other parts of society: car repair shops, new car dealers, and medical practitioners. Insurance companies make money, not through the actual accidents, but from people who pay insurance premiums yet don't end up needing insurance money.

POLLUTION AND SPEED

Lower speeds reduce emissions—up to a point. A car that drives smoothly and slowly will pollute slightly less that a car that drives smoothly and quickly. However, a car that stops and starts in traffic will also emit a good deal of pollution.

If one assumes that cars are already traveling faster than the speed limit, raising the limit may not necessarily raise emissions. But if the average speed does increase with the raised speed limit, then emissions will increase.

A DECISION CHART: HOW THE PIECES FIT TOGETHER

	OPTION 1	OPTION 2	OPTION 3
GOAL 1	*Outcome* *Probability* *Expected Value*	*Outcome* *Probability* *Expected Value*	*Outcome* *Probability* *Expected Value*
GOAL 2	*Outcome* *Probability* *Expected Value*	*Outcome* *Probability* *Expected Value*	*Outcome* *Probability* *Expected Value*
GOAL 3	*Outcome* *Probability* *Expected Value*	*Outcome* *Probability* *Expected Value*	*Outcome* *Probability* *Expected Value*

The Environmental Protection Agency (EPA) has found that 10 percent of the cars on the roads emit 50 percent of the pollution from cars. These "gross emitters" are cars that are not tuned correctly or do not have catalytic converters. The majority of cars built since 1990 emit small amounts of pollutants at any speed.

REVENUES FROM SPEEDING TICKETS

Many towns rely on revenues from motor vehicle tickets to pay for essential government functions. When speed limits are slightly lower than prevailing traffic, the police have more opportunities to issue tickets. Raising speed limits might reduce the number of tickets collected.

Motor vehicle crashes cost society an estimated $4,800 per second. The total economic cost of crashes in 1994 was estimated at $150.5 billion. The 1996 costs of speeding-related crashes were estimated to be $28.8 billion—or $913 per second.

Other ways to collect ticket revenues could be to increase ticketing for other offenses—such as broken lights or expired tags—rather than relying on speeding tickets.

Blank Decision Chart

	OPTION 1	**OPTION 2**	**OPTION 3**	**OPTION 4**
GOAL A:				
GOAL B:				
GOAL C:				

Using Graphing Calculators

The following steps are based on the TI-82 and TI-83 calculators. Other calculators have similar features, but the steps may not be exactly the same.

NOTE: Bold print indicates an actual button, such as the up arrow, on the calculator.
Italics indicate words which appear on the screen.

ENTERING DATA

1. Press **stat.**
2. Choose *1:Edit*.
3. Space for three lists should appear on the screen, labeled *L1*, *L2*, and *L3*. You can access additional lists using the right arrow to move the cursor past the edge of the screen.
4. Enter data by typing the number and pressing **enter** or the **down arrow** to scroll down the list.

CLEARING DATA

There are several ways to clear data that have already been entered in the lists. The easiest is to use the **up arrow** to position the cursor over the *L1* (or whatever list is to be cleared) and press **clear** followed by **enter**.

SORTING DATA

The options for sorting data can be found on the stat menu.

1. Press **stat.**
2. Choose between *2:SortA* (ascending order) and *3:SortD* (descending order).
3. You will be returned to the main screen and the operation you chose will appear. If anything else appears on the same line with the operation you chose, use the arrows to move the cursor over it and press **del** (delete).
4. Tell the calculator which list is to be sorted by choosing the appropriate *L_* from above the keys numbered 1 to 6. Be sure to press **2nd** to access the list desired.
5. Press **enter.** (Users of the TI-83 will need to close the automatic parentheses first).
6. The word *done* appears on the screen. The list is now sorted. Press **stat** and choose *1:Edit* from the menu to see the sorted list.

PLOTTING DATA

Both the TI calculators offer several types of graphs: scatter plot, line plot, histogram, and box-and-whiskers plot. This graphing feature is separate from the graphs of functions. For best viewing, turn off or erase any graphs stored under **y=**.

TO GRAPH STATISTICAL DATA

1. Press **2nd** followed by **y=** (stat plot)
2. A list of stat plots appears showing whether they are on and which type of graph they display. Choose a plot. Most likely all other plots should be turned off.
3. Use the **arrows** to move the cursor over *On* and press **enter.**
4. Using the **arrows,** choose a plot to be drawn. Choose a list to be the *Xlist*. Choose either the *Ylist* or the *frequency*, depending on which type of graph was selected. Note that the *frequency* and the *Ylist* can be an entered list or a constant number.
5. Press **graph.** The window may need adjustment. This can be done either by pressing **window** and entering the ranges desired or by pressing **zoom** and choosing one of the calculator-generated sizes.
6. Try using **trace** to move around the graph and observe its values. When used with the box-and-whiskers plot, **trace** will indicate the minimum, maximum, quartiles and median.

CALCULATING STATISTICS

The calculator will compute basic statistics on any data set entered in a stat list.

1. Press **stat.**
2. Use the **right arrow** to move the cursor to the second menu and press *calc*.
3. *1-Var Stats* is as far as most high school courses investigate. Choosing this feature will return the cursor to the main screen and write the words
1-Var Stat.
4. By default, the calculator will use L1. If another list is to be used, enter the list from above the 1 to 6 keys.
5. Press **enter**. The results of the calculations will appear. the results do not fit on a single screen so you will need to use the **down arrow** to scroll to see those which did not fit.

FINDING LINE OF BEST FIT

The calculator offers several regression analyses. The TI-82 provides a coefficient of correlation so students can see how exact the fit is, whereas the TI-83 does not. For both calculators the steps to calculate regression are the same.

1. Press **stat.**
2. Move cursor to *calc* menu.
3. Select the regression desired. This will return the cursor to the main screen.
4. Press **enter.**

Good Graphing Techniques

TABLE B.2

Data with point protectors

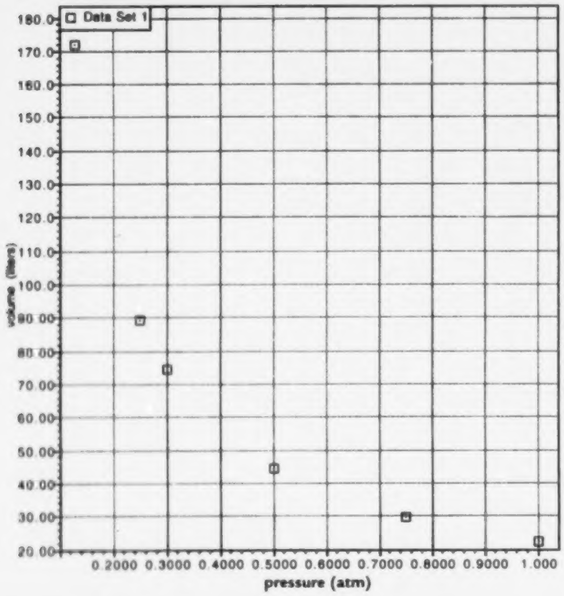
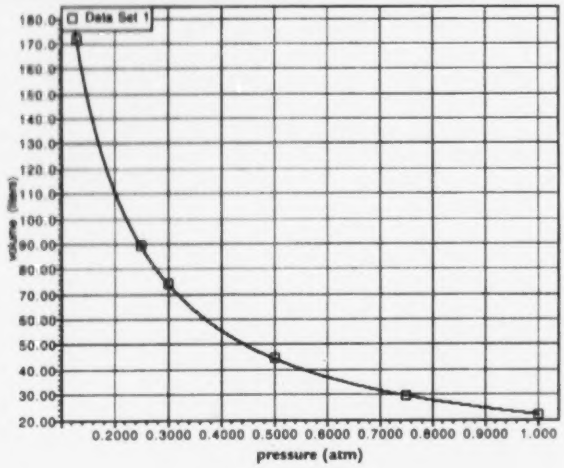


TABLE B.3

Data with fitted curve



$f(x) = 22.12\ x^{-1.006}$

$R = 1.00$

Good graphing techniques are extremely important to understanding data. Consider the data in Table B.1, which represent the relationship between the pressure (P) of a gas and the volume (V) the gas occupies. This principle is known as Boyle's Law.

TABLE B.1

PRESSURE ATM	ERROR IN P... +-ATM	VOLUME LITERS	ERROR IN V... +-LITERS
0.1300	0.02000	172.1	5.000
0.2500	0.02000	89.28	5.000
0.3000	0.02000	74.35	5.000
0.5000	0.02000	44.49	5.000
0.7500	0.02000	29.55	5.000
1.000	0.0200	22.08	5.000

Several things should be noted about the way the data are recorded. Each column of data are labeled with the quantity represented and the unit in which it was measured. The error in each measurement is also recorded. (Significant figures are used consistently.)

The first step in graphing these data are to decide which variable is the independent (placed on the X-axis) and dependent (placed on the Y-axis.) Boyle's Law is usually represented with pressure as the independent variable.

The second step is to establish a scale for each of the axes. The scale should evenly cover the entire range of data. However, it is not necessary to start at a "0" origin, or to show quadrants that do not have any data in them. This graph has a domain (X-axis) of 0.1300 to 1.000 atm and a range (Y-axis) of 22.8 to 172.1 liters. Each axis should be labeled with the quantity it represents and the unit in which it is measured. Also, each graph should have a title.

Notice the purpose of point protectors, the boxes around the data points. Point protectors allow you to see where the original points were located when additional information is added to the graph. (See Table B.2.)

One piece of information that can be added to a graph is a best fit curve. Students should be able to describe the data with a smoothly-drawn curve through the points. It is important for students to be able to decide when the data are best described by a line, connecting point to point, or a smooth curve. (See Table B.3.)

Error bars can be used to represent the error in each measurement. This error is an absolute error, and is expressed in the same units as the measurement. The size of the error bar should be to scale on the axis. Error bars are most commonly used on the dependent variable; however, they may also be used on the independent variable. (See Tables B.4 and B.5.)

TABLE B.4

Data with error bars in independent variables

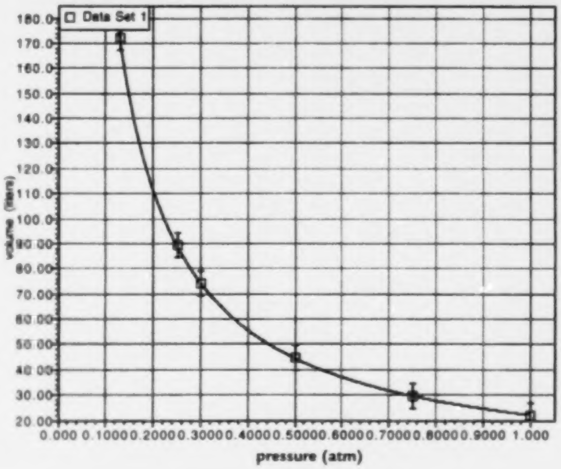
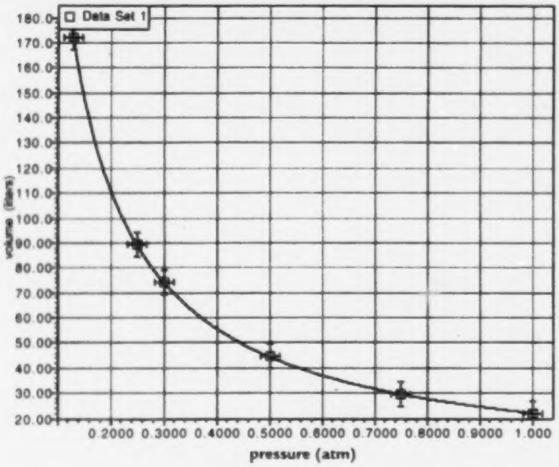


TABLE B.5

Data with error bars in both variables



Representing Data with Equations

The term regression refers to determining the mathematical equation that best represents the data. Traditionally, this was a tedious process requiring extensive algebra. However, new graphing calculators and computer programs now perform this task easily. (See Appendix A.)

If we consider the graph of Boyle's Law (as shown in Appendix B), we can describe the data as an inverse relationship. The formula for Boyle's Law, where P is pressure, V is volume, and k is the constant of proportionality, can be represented by:

$$V \alpha 1/P$$

or as an equality with k the constant of proportionality:

$$PV = k \text{ or } V = k/P$$

where V is on the Y-axis and P is on the X-axis. There are two effective ways to analyze these data. The first method uses a regression with the power function. This returns an equation in the form y = A*x ^B. Boyle's Law can then be described as:

$$Y = 22.12X^{-1.006}$$

This can be transformed into a recognizable form of Boyle's Law by the following:

$$Y = \text{Volume} = V \quad X = \text{pressure} = P$$

$$\text{substituting } C = 22.12P^{-1.006}$$

$$-1.006 = -1$$

$$V = 22.12P^{-1}$$

$$V = \frac{22.12}{P}$$

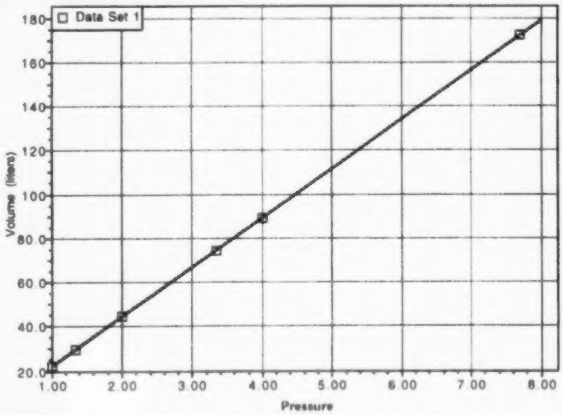
$$PV = 22.12 \text{ or } PV = k$$

Another way of describing these data would be to substitute the measurement X = 1/P. This will put the equation in the form V = kX, which is linear. The slope of the best fit line represents the value k.

Most calculators include a value that represents how closely the equation fits the data. This value, called the coefficient of regression or correlation coefficient, is represented by R or R^2. R will have the range of -1 to 1, depending on whether the data shows positive or negative associations. The closer the value is to -1 or 1 the better the regression curve fits the data. The value R^2 will have a range of 0 to 1. The closer the value is to 1 the better the regression curve fits the data. Because of the ease of trial and error, many people recommend simply trying different regressions and looking for the best correlation coefficient. However, a much greater understanding of the data can be found when the student understands the shapes created by different regression equations and can choose the regression that provides the most meaningful interpretation of the data.

TABLE C.1

Graph of 1/P



Algebraic Method of Determining Outliers

The word outliers indicates values that are widely separated from the rest of the data. If you think you have spotted an outlier, it is worth some special thought about why it is different from the rest. Trying to make sense out of the outliers can be an important part of interpreting data. It is not reasonable, however, to automatically call the upper and lower extremes outliers. Any data set has extremes, and we don't want to put extra energy into trying to interpret them unless they are separated from the rest of the data. It is helpful to have a test to aid in making the decision, especially when there are a moderate to large number of observations (say 25 or more.) The Q test is a simple algebraic test for determining if a value should be included in an average or if it is an outlier. Given the set of measurements determined experimentally:

SAMPLE	PERCENT IRON
A	36.04
B	36.09
C	35.12
D	36.07
E	36.10

The average (mean) of these data set is calculated to be: $\overline{x} = 35.88$, and the standard deviation is: $\delta = .428$.

Looking at the data, all of the values except C seem to closely agree. The Q test determines mathematically whether the trial C can be discarded from the average. The Q test is applied to the value that is furthest from the average—the deviant result.

$$Q \text{ is defined as: } \frac{|\text{deviant result} - \text{nearest neighbor}|}{\text{max value} - \text{min value}}$$

$$\text{For the data given: } \frac{|35.12 - 36.04|}{36.10 - 35.12} = \frac{.92}{.98} = .939$$

The calculated Q value is compared to a list of tabulated Q values which determine the confidence with which the value can be discarded. For typical data analysis, a confidence of 90 percent is usually used. If the calculated Q value is larger than the tabulated value, the trial should be discarded as an outlier. The values for Q - 90 are:

NUMBER OF MEASUREMENTS	Q - 90
3	.94
4	.76
5	.64
6	.56
7	.51
8	.47
9	.44
10	.41

For our example, we have 5 trials. Because the calculated Q is larger than .64, trial C can be discarded as an outlier. The mean and standard deviation can then be recalculated:

New average (mean) without trial C: $\overline{x} = 36.08$

New standard deviation: $\delta = .026$

Bibliography and Resources

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Landwehr, James M., and Watkins, Ann E. 1996. *Exploring Data: Revised Edition.* Palo Alto, CA: Dale Seymour Publications.

National Research Council. 1996. *National Science Education Standards.* Washington, DC: National Academy Press.

Tufte, Edward E. 1983. *The Visual Display of Quantitative Information.* Cheshire, CT: Graphics Press.

DATA RESOURCES

The following publications are provided as sources of data. The information they provide can be adapted to fit many of the activities in this book, or assigned as practice and/or assessment exercises.

Barracato, Jay. 1998. *Toxics Release Inventory: Teachers Guide.* (Volume 1 in the *Teach With Databases* series.) Arlington, VA: National Science Teachers Association.

Hassan, John, ed. 1997. *The 1998 ESPN Information Please Sports Almanac.* New York, NY: Warner Books.

Hughes, M., *et al.* 1996. *1996–1997 Hockey Almanac.* New American Library.

Johnson, Otto, ed. 1997. *The 1998 Information Please Almanac.* New York: Information Please LLC.

Mass Market Paperback, ed. 1996. *1996 Baseball Almanac.* New York, NY: Signet.

Strasen, Marty. 1996. *1996–1997 Basketball Almanac.* New York, NY: Signet.

NSTA CURRICULUM RESOURCES

The following publications provide background information on teaching and assessment strategies that may be useful to utilize while teaching students about databases.

Doran, Rodney, *et al.* 1998. *Science Educator's Guide To Assessment.* Arlington, VA: National Science Teachers Association.

Campbell, V., Lofstrom, J., and Jerome, B. *Decisions—Based on Science.* Arlington, VA: National Science Teachers Association.

Tierney, Bob. 1996. *How to... Write to Learn Science.* Arlington, VA: National Science Teachers Association.

DATABASES

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- Working with [illegible]
- Plotting data
- Describing data with [illegible]
- Preparing [illegible] of data
- Explaining data with graphs
- Weighing data when making decisions

Each activity includes teaching tips, data collection methods, sample data sets, procedures, student worksheets, and assessment suggestions. Extensive background information provides suggestions for incorporating these data skills into the science curriculum and discusses how these skills fit the *National Science Education Standards*. If you've considered teaching with a database, *Database Basics* will help you use these important resources to give your students a new appreciation for the process of science.

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Environmental Protection
Agency

Office of Pollution
Prevention and Toxics

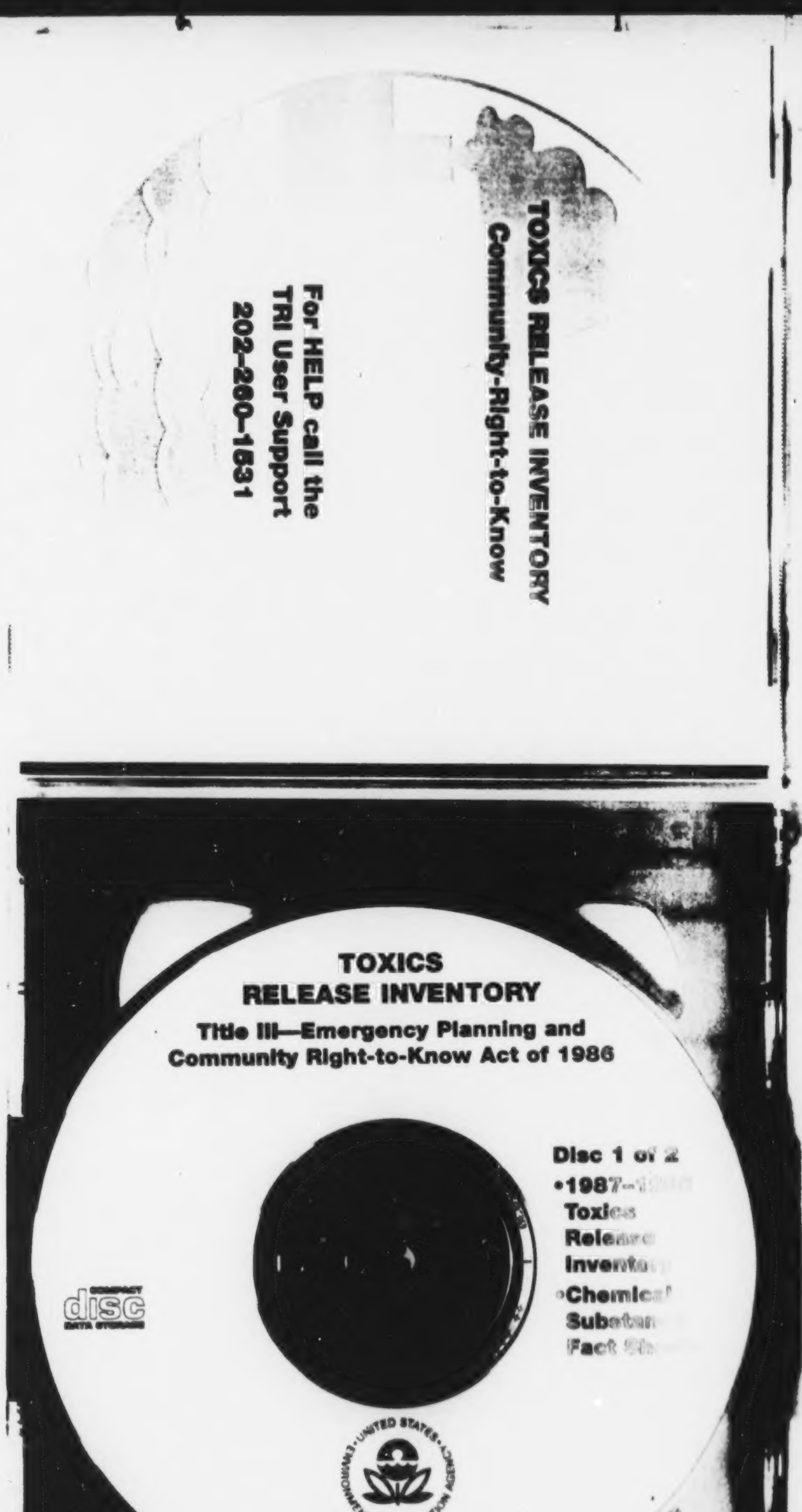
EPA 749-C-95-004
June 1995

EPA

1987–1993 Toxics Release Inventory

CD–ROM Quick Reference Guide

Printed on Recycled Paper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PREVENTION AND TOXICS
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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES, AND
TOXIC SUBSTANCES

Dear Toxics Release Inventory Release Users:

I am pleased to be sending you the 1987-1993 Toxics Release Inventory (TRI) CD-ROM. This year, the CD-ROM is being distributed as part of a kit. In addition to the two-disc CD-ROM set, you will receive a comprehensive User's Manual as well as a Quick Reference Guide. These CD-ROMs supersede discs released in earlier years.

What are the basic software features?

- help screens and system messages and prompts
- combining searches using Boolean operators
- numeric ranging
- displaying or sending records to a printer or to disk
- exporting records to disk in several formats
- user selection of fields for printing, displaying and exporting
- sorting and ranking fields
- statistical analyzer (KASTAT)
- form designer for creating custom reports

What's new on the CD-ROM?

EPA has made a number of improvements in the disc structure and the software to improve access to the TRI. For the 1987-1993 CD-ROM, we have:

* **Updated the data and restructured the discs by year.** Disc One contains the 1987-1990 TRI; Disc Two lists 1991-1993 TRI data.

* **Decreased the amount of memory required** from 540K to 510K for full functionality of TRI retrieval software.

* **Developed a new, menu-driven installation program.** Front-end module steps the user through installation, including selection several new choices this year.

Recycled/Recyclable • Printed with Vegetable Oil Based Inks on 100% Recycled Paper (40% Postconsumer)

* **Lengthened the field labels to make them more easily understood.**

* **Added a data element indicating Federal facilities,** in anticipation of mandatory reporting by Federal facilities, effective for reporting year 1994.

* **Provided options to limit DOS access.** Choose during installation whether to allow "Temp Exit to DOS." Also, invoke optional password control to restrict users from exiting CD-ROM to DOS.

* **Added a new export format.** "WP [Word Perfect] Merge Format" is now available, as well as five other popular formats.

* **Doubled the number of records that can be processed by the built-in statistical analyzer to 6,000.**

* **Increased options for ranking data.** Now users can enter numbers indicating the relative order of importance of search terms by number in several new instances.

* **Released the manual and the discs simultaneously.** In addition, the manual is provided on Disc One in the README directory.

I would like to invite those of you who will no longer need the TRI CD-ROMs that you received last year to return them to EPA for reuse. We are planning now for an educational outreach program that would enable us to redistribute discs to schools. Please send them to: Kathy Hogan, EPA/OPPT (7407), 401 M Street S.W., Washington, DC 20460, or use the enclosed return label.

Sincerely,

Linda A. Travers

Linda A Travers, Director
Information Management Division

United States
Environmental Protection
Agency

Pollution Prevention
and Toxics (7407)

EPA 749-C-95-004
June 1995

EPA

Toxics Release Inventory

1987-1993 CD-ROM User's Manual

For sale by the U.S. Government Printing Office
Superintendent of Documents, Mail Stop: SSOP, Washington, DC 20402-9328
ISBN 0-16-048124-4

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1.0 Introduction

This chapter will explain the use of this Manual and its format. It contains a brief overview of the Toxics Release Inventory (TRI) System and a description of each of the media formats in which TRI is published. A list of other reference materials also is provided at the end of the chapter.

1.1 Organization of This Manual

This Manual is intended as both a learning and a reference tool for TRI CD-ROM users. It explains the operation of the TRI CD-ROM software and includes corresponding screen illustrations and examples. The Manual is not intended to provide detailed technical guidance about the TRI program or interpretation of data submitted by individual reporting facilities. The remaining chapters consist of:

Chapter 2 - Accessing TRI On CD-ROM

Chapter 3 - Chemical Substance Fact Sheets

Chapter 4 - Toxics Release Inventory Database

Chapter 5 - Performing Calculations With KASTAT

Additionally, there are four appendices containing information to assist you in using the TRI CD-ROM. For example, Appendix C, TRI Quick Search Guide, provides abbreviated instructions that allow the user to effectively search TRI and use other features of the disc right away.

1.2 User Manual Conventions

To assist you in the use of this Manual, some conventions used throughout this Manual are listed below:

- Keys to be pressed are shown with capital letters, bold type, and within angle brackets. For example, the enter key is represented as **<ENTER>**.
- Names of screens and menus are shown in capital letters and bold type. For example, **DATA BASE SELECTION MENU**.
- **<ENTER>** refers to the enter key or the return key.

1.3 An Overview of the Toxics Release Inventory

1.3.1 Background

In 1984, a deadly cloud of methyl iscyanate killed thousands of people in Bhopal, India. Shortly thereafter, there was a serious chemical release at a sister plant in West Virginia. These incidents underscored demands by industrial workers and communities in several states for information on hazardous materials. Public interest and environmental organizations around the country accelerated demands for information on toxic chemicals being released "beyond the fence line" outside of the facility.

1.3.2 The Emergency Planning and Community Right-To-Know Act

Against this background, the Emergency Planning and Community Right-to-Know Act (EPCRA) of 1986 was enacted. Hailed as one of the most potent pieces of environmental legislation in 20 years, EPCRA's primary purpose is to inform communities and citizens of chemical hazards in their areas. The Act provides for the collection and public release of information about the presence and release of hazardous or toxic chemicals in our nation's communities. The law requires industries to participate in emergency planning and to notify their communities of the existence of, and routine and accidental releases of, hazardous chemicals. The goal is to help citizens, officials, and community leaders to be better informed about toxic and hazardous materials in their communities. Sections 311 and 312 of EPCRA require businesses to report the locations and quantities of chemicals stored on-site to state and local governments. This helps communities prepare to respond to chemical spills and similar emergencies. The goal is to reduce risk for communities as a whole.

Through EPCRA, Congress mandated that a Toxics Release Inventory (TRI) be made public. TRI provides citizens with accurate information about potentially hazardous chemicals and their use so that communities can hold companies accountable and make informed decisions about how toxic chemicals are to be managed.

Section 313 of EPCRA specifically required manufacturers to report releases of over 300 chemicals that had been designated as toxic to the environment. (From its inception in 1987 through 1993, the years contained on this CD-ROM, the number of chemicals covered by remained fairly constant. Beginning in 1995, however, companies will have to report releases for about 600 chemicals.) The reports are submitted to the U.S. Environmental Protection Agency (EPA) and state governments. EPA compiles this data into an on-line, publicly accessible, national inventory. Many states also make TRI available. This vast source of data is widely recognized as a powerful force for environmental improvement.

Facilities are required to report on releases of toxic chemicals into the air, water, and land. Additionally, they must report off-site transfers of wastes to a separate facility for treatment or disposal. Facilities are also required to report on pollution prevention activities and chemical recycling. Reports must be submitted on or before July 1 each year and must cover activities that occurred at the facility during the previous year.

1.3.3 TRI Reporting Requirements

A facility is required to report if it..

- Has ten or more full-time employees; and
- Manufactures or processes over 25,000 pounds of toxic chemicals or chemical category specified by law or added through rulemaking, or uses more than 10,000 pounds of any designated chemical or category; and
- Conducts selected manufacturing operations in the industry groups specified in the U.S. Government Standard Industrial Classification (SIC) Codes 20 through 39.

Under the present reporting requirements, about 80,000 reports - representing billions of pounds of chemical releases - are submitted to EPA each year by more than 20,000 manufacturing facilities.

By Executive Order, Federally-operated facilities (e.g., military installations), heretofore exempt from TRI reporting, will be subject to TRI reporting beginning with reports due July 1, 1995. The following year, a new reporting threshold designed to reduce the burden on small businesses will go into effect. Businesses whose total releases and wastes for a TRI chemical are less than 500 pounds per year will be permitted to submit a simplified version of Form R. The latter change will coincide with an increase in the number of TRI chemicals from about 300 to nearly 600 chemicals. EPA is presently considering expanding the types of facilities subject to TRI reporting.

1.3.4 Scope of the TRI

TRI is unique in that it marks the first time that the public has direct access to detailed information about releases of toxic chemicals in their communities. TRI offers an opportunity for citizens to increase their knowledge of chemical usage in their area and to use this knowledge to affect community environmental policy and change.

The TRI database includes information on:

What chemicals were released into the local environment during the preceding year;

How much of each chemical went into the air, water, and land in a particular year;

How much of the chemicals were transported away from the reporting facility for disposal, treatment, recycling, or energy recovery;

How chemical wastes were treated at the reporting facility;

The efficiency of waste treatment; and

Pollution prevention and chemical recycling activities.

TRI provides the first comprehensive overview of toxic chemical pollution from manufacturing facilities in the United States. It is a public "report card" for the industrial community, creating a powerful motivation for waste reduction. This annual accounting of the nation's management of industrial toxic chemical wastes is a valuable source of information for concerned individuals and communities. Citizens can use TRI to evaluate local facilities through comparisons, determine how toxic chemicals are used, and, with other information, evaluate potential health risks for their community. Organizations can use TRI information as a starting point for constructive dialogue with manufacturing businesses in the area.

Although TRI offers valuable insight into chemical pollution in the U.S., it is important to recognize that it also has limitations. For example, TRI covers toxic chemicals released by manufacturing operations only. Options for expanding TRI to include non-industrial sources are being studied for future implementation. Reported releases are annual estimates based on accepted estimation techniques, not necessarily exact measurements. The amounts reported could have been released evenly over the course of the year or, possibly, in a single large burst. Another important point to consider when using TRI data to consider health affects is that it cannot be used alone; additional information is necessary to ascertain levels of risk or exposure (see 1.3.7). Nevertheless, TRI provides communities with a springboard from which citizens can seek further vital information about toxic chemicals in their area.

1.3.5 Pollution Prevention and TRI

Following implementation of the Pollution Prevention Act (PPA) of 1990, TRI reporting became even more comprehensive. Historically, government agencies and waste generators have tried to resolve environmental problems using "end-of-pipe" waste management practices; that is, treating or disposing of waste after it has been created. Pollution prevention strategies focus instead on avoiding creation of wastes by redesigning products, changing processes, substituting other raw materials for more toxic substances, and other techniques.

With passage of the PPA, Congress adopted as national policy an environmental hierarchy that establishes pollution prevention as the first choice among waste management practices. For waste that cannot be avoided at the source, recycling is considered the next best option. A waste generator should turn to treatment or disposal only after source reduction and recycling have been considered.

Reporting requirements for TRI changed in 1991 as a result of the PPA. Prior to 1991, facilities were required to report toxic substances released into the environment and transferred off-site for treatment or disposal. Beginning in 1991, facilities were also required to indicate amounts of chemicals that are recycled, used for energy recovery, and treated on-site. (Energy recovery means burning the chemical so that resulting heat energy contributes to subsequent manufacturing operations.) These amounts must be reported for the past year and the current year, as well as projected amounts for the next two years. Furthermore, facilities must indicate source reduction activities that have been implemented.

These changes to TRI highlight the importance of pollution prevention and encourage reporting facilities to develop and implement strategies for reducing waste. This information will also help the public gauge industry's commitment to improving the nation's environment. By working together, businesses and neighboring communities can build on emerging pollution prevention practices for everyone's benefit.

1.3.6 Using the TRI

The Toxics Release Inventory is a rich source of data for a broad-based audience that includes manufacturers, environmental consulting firms, trade associations, labor groups, health professionals, state and local environmental agencies, Local Emergency Planning Committees (LEPCs), and federal agencies. An important and growing user group is concerned citizens who, on their own or through organized groups, use TRI to raise and answer questions about chemical releases in their communities.

Whether the TRI is used to influence local government action, emergency planning, the education of citizens, or to spur industry-citizen cooperation, it is clear that it plays an important role in understanding trends in environmental releases and chemical waste management.

The following examples illustrate the way TRI is used by various groups:

> **Citizens** The Emergency Planning and Community Right-to-Know Act (EPCRA) was written with individual citizens in mind, on the principle that the more citizens know, the more effective they can be at improving health and safety by avoiding chemical hazards in their communities. TRI enables citizens to become more aware of toxic chemicals in their own neighborhoods. It encourages dialogue between individuals and local companies which can result in a change in current practices, and improve the local environment. Citizens often use the TRI data in combination with other information sources to explore health-related risks in their communities.

Businesses Manufacturers can use the TRI data as a basis for reducing large stocks of toxic chemicals located in dense population areas or to lower levels of chemical releases. TRI data is also used to cut costs and improve operations. "Wastes" represent an expense - chemical wastes leftover after manufacturing must be managed, which may include treatment or disposal or removal from the facility. Companies are using TRI to increase awareness of environmental business opportunities and, as a result, reduce the use of toxic chemicals. TRI is also used to market a chemical or process that is cleaner, safer, or more cost-effective for the reporting facilities. Law firms, real estate companies, and banks use TRI to identify potential liability issues associated with a particular parcel of land. Most importantly, the publicity that has resulted from the availability of TRI data has caused many companies to voluntarily pledge toxic chemical release reductions. A portfolio management group illustrates another way TRI data is used by the private sector: the Clean Yield Group uses TRI and other data sources to track companies' environmental performance for potential investors.

Educators Academic researchers rely on TRI data to conduct important studies of the environment. Several universities use TRI reports to study how chemicals are used and to develop alternative technologies for the prevention of toxic releases. Increasingly, TRI is being coupled with other data, such as economic indicators, to study social policy and economic development. In the classroom, TRI is a resource for students who examine local sources of chemical pollution and prepare toxic waste audits on communities or facilities. Currently, the TRI data base is being used as a basis for the development of a series of cross-curriculum student activities in the classroom.

Public Interest Groups Public interest groups make effective use of the TRI data to educate citizens, prepare revealing company profiles and influence change. Most often, they use TRI to bring public pressure to bear on facilities and public officials. One illustration of successful use of TRI by a public interest group is the Hudson River Sloop Clearwater, Inc., which uses TRI data to track chemical releases in the Hudson River drainage basin. They have produced three reports and seek to actively educate their membership and the public. The New York Public Interest Research Group released TRI data to coincide with local public hearings on toxics use reduction, and helped pass a bill expanding state TRI coverage to power plants and transportation facilities. The Georgia Environmental Policy Institute is sponsoring preparation of a citizen's guide for using TRI, Census and other information to help define areas with potential environmental justice concerns. These are but a couple examples of many, many instances where TRI has made a difference in citizens' ability to monitor and influence the quality of their local environment.

Labor Concern for worker safety was a key factor in the original passage of the national legislation. Providing workers the right-to-know about chemical hazards in the workplace has been a consistent goal of organized labor since the early 1970s. For example, one large textile workers union teamed up with a Minnesota community and used the TRI data to pressure their company to reduce the use of methylene chloride, a known health hazard to the workers, and search for safer alternatives. Union members and activists pressured the state for tougher regulations that would force the company to cut emissions by 93 percent. Publication of toxics release data often makes it easier for labor organizations to lobby successfully for safer practices to protect workers' health.

State Emergency Response Commissions (SERCs) EPCRA requires each state to set up a SERC to designate local emergency planning districts within the state, and coordinate activities and review plans of the local committees. The SERCs serve as a liaison between the state and EPA and provide the forum for coordinating all Title III information (although another state agency may be designated to collect TRI data). Each SERC works to ensure that its state programs are integrated with the federal law to strengthen enforcement. It provides leadership, coordination, technical assistance, and training - working closely with the LEPCs - to help individuals and organizations meet their responsibilities under the Act.

Local Emergency Planning Committees (LEPCs) EPCRA required each SERC to establish LEPCs to develop and periodically review emergency plans to prepare for and respond to chemical emergencies. By law, LEPCs include representatives from state and local government, civil defense, fire fighting, health, environmental and transportation agencies, the media, community groups and businesses subject to EPCRA reporting. LEPCs use TRI data, as well as information about chemicals stored on-site by local facilities, for their own planning purposes. They also make this information available to the public upon request.

State and Local Agencies TRI data is useful to hospitals, schools, and state and local governments for emergency planning and response at the state and local level. Many emergency management agencies, fire departments, and emergency medical services use TRI to identify chemicals in use and map facility locations for more effective, quicker response to emergencies. The TRI data is also used to identify the need for and pass state and local legislation. For example, Louisiana used the TRI data as the basis for passing a new Air Toxics law requiring a 50 percent reduction of emissions by 1996. TRI is also used in combination with other data to determine whether companies are complying with environmental legislation already in effect. For example, TRI data on off-site transfers can be used to identify chemicals or wastes being transported from a facility and to verify that the receiving landfill has the proper permits for the incoming amount and types of waste.

U.S. Environmental Protection Agency (EPA) TRI is used by EPA as a baseline for measuring improvements in companies across the nation. Company performance records are tracked over time to monitor voluntary pollution prevention efforts, and to oversee emission reductions called for under the Clean Air Act Amendments of 1990. TRI is used throughout the EPA to measure company compliance with other laws and to target areas where enforcement of other regulations is needed, to gauge the need for additional regulatory efforts to clean up water, air, and solid waste problems, and to develop strategies for assessing pollution prevention programs.

Federal Agencies TRI data is used extensively at the federal level for a variety of programs. Congress relies on TRI figures to develop environmental legislation. Through TRI data, federal lawmakers discovered that the nation's original Clean Air Act toxics control program was not adequate - of the top 25 toxic chemicals reported to TRI as released to the air, only two were regulated by the Clean Air Act. In 1990, amendments to the Clean Air Act required additional reporting for designated "hazardous air pollutants" and made manufacturers develop risk management plans, shifting the initial emergency planning burden from the mostly-volunteer LEPC to industry. The Agency for Toxic Substances and Disease Registry, a federal public health agency whose job it is to prevent or minimize adverse health effects from exposure to hazardous substances, uses TRI data to set goals for improving the nation's health. The Internal Revenue Service has used TRI data to measure compliance of reporting companies with tax laws pertaining to the use of toxic substances.

Health Officials TRI data can be used to build an information base on hazardous chemicals used, manufactured, or transported in a state or community. Health professionals can use this information to better prepare personnel for emergencies. TRI can help diagnose, treat or study health effects resulting from chemical exposure in the community or workplace. (See 1.3.7)

Media TRI is important to the education of the community about facilities and potential hazards in the local area. Many large newspapers, such as USA Today, the New York Times, and the Wall Street Journal have run stories on the effectiveness of the right-to-know statute, as have scores of local newspapers, trade and labor union publications, and periodicals.

International TRI enhances the ability of the global community to work as one in monitoring the earth's environment. Several nations use the data to assist in their efforts to become more environmentally conscious. Environment Canada uses the TRI data to determine which industries and chemicals need greater regulation in their country; it developed a National Pollutant Inventory modeled on TRI. In recent years, when many eastern European countries turned their attention to the environment, several nations began considering implementation of programs similar to TRI. One country used TRI data to evaluate companies interested in opening facilities there. Other users of TRI around the world include Great Britain, continental Europe, India, and Japan. International organizations, particularly other governments, are one of the fastest growing segments of the TRI user community.

1.3.7 TRI & Health

Viewing TRI data for the first time often triggers concern about the health risk posed by the release of chemicals that are listed in the data base. You may ask, or others may ask you, how toxic a particular chemical is, or whether the volume of releases shown in TRI will adversely affect their health or the environment. These are not easy questions to answer, and cannot be answered by TRI alone. *Risk* is the measure of the chance that you will experience health problems or that the environment will be degraded. Many factors must be considered in order to evaluate what risks, if any, you face from the presence of toxic chemicals in your local environment. *Risk screening* uses available information, such as TRI, to develop a relative estimate of risk for a given set of conditions. Risks are ranked as high, medium, or low in order to set priorities for further evaluation.

The TRI data is a first link to discovering which chemicals being manufactured, released, or transferred in your community pose a threat to human health and the environment. The TRI will tell you the names and estimated amounts of chemicals released in your area during the preceding year. You can also find out about chemicals that were transferred into or away from your area for treatment and disposal.

This information alone does not indicate the risks that these chemicals pose or may pose to human health and the environment. Small releases of highly toxic chemicals may be a greater risk than very large releases of less toxic chemicals. Though the TRI data is useful to evaluate the risk in your community, other information is required to form a complete picture. A determination of risk depends on the release conditions, extent of exposure, environmental conditions, and other factors.

The presence of a chemical on TRI does not necessarily represent a health risk. Other factors, such as the level and type of exposure and toxicity, also must be considered. For example, some high-volume releases of relatively non-toxic chemicals may appear to be a more serious problem than low-volume releases of highly toxic chemicals. However, just the opposite may be true. Volume does not always indicate danger or a need for serious concern. Reports of TRI data contain releases of chemicals, not the level of exposure to these chemicals. It is important to review all the variables involved in the reporting of TRI data. Other information, in addition to TRI data, must be considered to determine the impact of a chemical release on your health.

1.3.8 If You Want More Information

Once you become aware of toxic chemical releases in your community, you may want additional information or assistance. Here are several suggestions for following up in your community:

Learn the facts. In addition to chemical release information, TRI contains the names and telephone numbers of public contacts at reporting facilities. Companies are becoming more sensitive to citizens' concerns about health and the environment, and some have begun community outreach programs. Company officials may provide answers to your questions that could affect risk screening. They can also steer you towards local agencies, for example, the Local Emergency Planning Committee (LEPC).

Go to the local library. Ask your librarian to help you find information about chemicals in your community. There are many reference works that examine chemical toxicity and other factors to help you decide whether further investigation is warranted.

Identify local safety and public health agencies. These groups can help you evaluate what you have learned and identify any additional information you may need. Most counties have a public health agency staffed by one or more doctors, including a county health officer. Some areas have poison control centers with toxicologists and other staff who may be of some assistance. If you have difficulty identifying appropriate agencies in your area, call the local hospital or fire department for a referral.

Locate the Local Emergency Planning Committee (LEPC). The EPCRA legislation that created TRI also established LEPCs to plan for emergency action in the event of hazardous chemical spills and similar incidents. LEPCs are aware of hazardous chemicals used and stored by facilities in your area. They receive Material Safety Data Sheets that detail physical properties and health effects of hazardous chemicals used by local manufacturers and other facilities. LEPCs, while often associated with existing county-level emergency planning or civil defense agencies, include representatives of environmental and transportation agencies, fire fighters, hospitals, the media, community groups, and others.

Call the Agency for Toxic Substances and Disease Registry (ATSDR). The ATSDR is the leading federal public health agency concerned with risks resulting from chemical exposure. Located in Atlanta, GA, it was created by the Superfund legislation in 1980. ATSDR makes information on the health effects of hazardous substances available to the public, conducts health assessments, and sponsors research. The ATSDR publication series titled Toxicological Profiles characterizes toxicological properties and health effects information for specific chemicals so they can be understood by a lay person. These publications, widely distributed to libraries across the country, are invaluable if you are interested in a specific chemical. ATSDR maintains contacts with state and local health agencies throughout the U.S. (For more information, call ATSDR at (404) 639-6300 or fax your request for a specific Toxicological Profile to (404) 639-6315.)

Contact the regional EPA office serving your area for more information about TRI facilities near you. Each of the ten regional offices has a designated TRI coordinator who can answer your questions about the TRI program and reporting facilities in your area. (See the list of provided on the disc in a file called \readme\regions.epa.) You may also call TRI User Support to learn more about obtaining or using TRI information products. Finally, the EPCRA Hotline (800-535-0202) can provide detailed information about TRI reporting requirements.

Contact your local college or university. Leading experts can often be found in the academic community, and professors and staff are often willing to share their knowledge with local residents. Be prepared to make a few phone calls. Several attempts may be necessary to find the right department or person.

Network with neighbors and community groups. This is a good way to exchange information, participate in meetings with officials, experts, and company representatives and plan activities that address your concerns. The more people are involved, the more attention you are likely to receive from industry officials, government agencies, and the news media.

1.4 Media Formats for TRI

TRI is available in several media formats. The two government agencies listed below make selected formats available to the public. Availability of specific products and prices vary from one agency to another. Call these agencies directly for up-to-date ordering information.

U.S. Government Printing Office (GPO)
710 North Capitol Street, N.W.
Washington, D.C. 20401
202-512-1800 (general sales)
202-512-1530 (computer products)

National Technical Information Services (NTIS)
U.S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161
1-800-553-NTIS (rush orders only)
703-487-4650 (sales)
703-487-4763 (computer products)

1.4.1 TRI Data On CD-ROM

As indicated by this User Manual, TRI data is available on CD-ROM. The CD-ROM edition is comprised of two discs, distributed as a set. Together, the two discs contain the complete TRI for the years 1987-1993. Disc One contains TRI data submitted for 1987-1990. Data for 1991-1993 is provided on Disc Two. (Data on each disc is divided into two files, Releases and Treatmnt. See Section 2.2 for a more detailed description of the data base structure.) Each disc also contains a complete set of Chemical Substance Fact Sheets, which provide reference materials on the health and ecological effects of the TRI substances. Some of the software capabilities include searching TRI data, downloading data, creating custom reports, and performing calculations on chemical release amounts. Data can be retrieved by chemical name, facility name, location, industry code and numerous other categories.

Some of the basic features of the CD-ROM are:

- help screens
- system messages and prompts
- combining searches using Boolean operators
- numeric ranging
- displaying records on screen, or sending them to a printer or to disk
- exporting records to disk in several formats
- user selection of fields for printing, displaying and exporting
- sorting and ranking fields
- optional features to limit DOS exit
- statistical analyzer (KASTAT)
- form designer for creating custom reports
- brief user guide

1.4.2 TRI Data On Floppy Diskette

TRI can be accessed on the personal computer (PC) through the use of several different software packages. Floppy diskettes are compatible with the IBM PC microcomputer and may be available in a choice of sizes, depending on the source. The user can buy diskettes for a single state, a set of several different states, or all states in dBASE III Plus format or in Lotus 1-2-3 format. Floppy diskettes contain the most frequently used TRI data, including the TRI facility identification number, name of the reporting facility, the facility's county, city, state, zip code, Standard Industrial Classification code, parent company name, chemical name and Chemical Abstracts Service Registry Number, aggregated chemical releases to the air, land, underground injection wells, and water, as well as total chemical transfers to off-site locations and publicly owned treatment works. In addition, the diskettes include the public contact name and phone number, longitude and latitude, state/county FIPS (Federal Information Processing Standards) code, and various EPA-assigned waste permitting identification numbers. Diskettes containing data for 1991 and later also contain selected pollution prevention data that were added to TRI as a result of the Pollution Prevention Act of 1990. Diskettes are also available in the Macintosh worksheet format (.MAC) for 1989. Documentation for all versions is provided.

1.4.3 TRI Data Through On-line Databases

TRI is a component file of the Toxicology Data Network (TOXNET) operated by the National Library of Medicine (NLM) of the National Institutes of Health. TOXNET offers state-of-the-art, user-friendly searching, utilizing a free text search capability, full Boolean logic, a powerful and flexible command language and a variety of on-line user assistance features. On-line and off-line printing of entire or specific portions of records is available, as are a variety of customized print options. Special TRI features allow sorting and numerical manipulation of data. A menu-driven search package also allows novice users or individuals with limited computer skills to search TRI efficiently. TOXNET is available seven days a week, 24 hours a day, and a fee is charged per each hour of access. A modem is required for access. If you are interested in accessing TRI through NLM, contact:

> TRI Representative
> National Library of Medicine
> Specialized Information Services
> 8600 Rockville Pike
> Bethesda, MD 20894
> (301) 496-6531

1.4.4 TRI Data on Internet

TRI data is now available through the Internet in several ways. EPA has recently established an agency-wide Gopher server and a World Wide Web (WWW) server allowing access to a broad range of environmental information. (A Gopher server is a menu-driven, user-friendly system allowing access to an organized collection of files over the Internet, as well as access to other Internet systems and services through the use of links. A World Wide Web is a more sophisticated version of a Gopher server that allows both viewing of graphics and 'point and click' access to different menu levels.)

The address for the EPA gopher is: gopher.epa.gov, while the address for the WWW server is: http://www.epa.gov. To browse TRI data from the menu, select the following menu choices:

EPA Offices and Regions/
  Office of Prevention, Pesticides, and Toxic Substances/
    Toxic Substances/
      1993 Toxic Release Inventory/

You can also use the keyword search capability on the Gopher main menu to access the last menu option directly. The metadata Record and Index provide descriptive information about the contents of the TRI data files.

The National Library of Medicine's TOXNET data base, including all data for TRI reporting years from 1987-1993, is also available on the Internet. An NLM user account is required to access the data base. The Internet address for NLM is: toxnet.nldm.nih.gov, which users can access using the telenet function in Internet.

1.4.5 TRI Data On Magnetic Tape

The TRI is available for each annual inventory on 9 track tape, 1600 or 6250 density, ASCII or EBCDIC format, with accompanying documentation. Tapes include printing instructions or codes and text. Complete TRI data is available on tape. A subset of the data called "Reporting Facilities Names and Addresses" is also available on tape.

1.4.6 Printed Reports About TRI

Every year, EPA publishes one or more printed reports highlighting the most recent TRI data available to the public. The first three reports (also called "national reports") contain analyses describing trends in geographic distribution, industrial patterns of releases and transfers, pollution prevention, and data usage. National reports were published under differing titles in 1989, 1990 and 1991. Every Spring since 1991 and continuing to the present, EPA has issued a Public Data Release Report. These reports contain numerous tables accompanied by explanatory text aggregating release data by chemical, state, industry, etc. Tables also highlight facilities with the largest releases nationwide, the greatest change from the preceding year, etc. Both national reports and public data release reports are widely distributed by EPA and made available to selecting Federal depository libraries. A limited number of copies are available (until stock is exhausted) from TRI User Support (see 1.5).

1.4.7 TRI Data on Microfiche

TRI data for 1987-1990 is available on microfiche at many public and depository libraries. The microfiche version contains TRI data for each state and U.S. territories and includes 12 indices to use for searching of data. Each set of fiche consists of three parts. Part 1 is the Introduction and contains a list of chemicals reported, a directory of EPA and State TRI contacts, a guide to searching the fiche, and other reference material. Part 2 contains the index to the chemical substance names, names of facilities, publicly owned treatment works, off-site transfer locations, and other facility information. Part 3 contains the TRI submissions of each State and U.S. territories. TRI is no longer being published in microfiche format.

1.4.8 TRI Data On Electronic Bulletin Board

If you have a personal computer, a modem, telecommunications software, and a telephone line, you can obtain TRI data electronically by calling the Federal Bulletin Board sponsored by the Government Printing Office. This service will allow you to browse a TRI Library, order diskettes, or download data directly to your computer. Anyone can access the Federal Bulletin Board by calling (202) 512-1357. A GPO deposit account number is required to place orders electronically. For more information about this service, call GPO at (202) 512-1530.

1.5 TRI User Support

For the convenience of TRI data users, EPA offers users support services over the telephone. Staff are available on weekdays from 8:00 a.m. until 4:30 p.m to assist you in obtaining or using TRI information products. Experienced personnel can answer your questions about installing the CD-ROM, search strategies for using the CD-ROM or TRI/TOXNET, or accessing TRI on Internet or by other means. They can also refer you to state and EPA regional offices in your area, as well as the closest Federal depository library where TRI may be available to the public. TRI User Support maintains the latest information for ordering TRI information products from GPO and NTIS. Limited training services may be available. To contact TRI User Support, call (202) 260-1531.

1.6 Other Available Reference Materials

There are many reference materials that provide additional information about the Community Right-to-Know Act and the Toxics Release Inventory. The aforementioned TRI User Support (see Section 1.5) may also be able to offer assistance in obtaining publications. Materials are free, unless otherwise indicated. The following materials published by EPA are available through the EPCRA Hotline (1-800-535-0202; 703-412-9810 in the Washington, DC area; 800-553-7672 for TDD equipment for the hearing impaired):

Chemicals In Your Community: A Guide to the Emergency Planning and Community Right-To-Know Act, 1988 (36 pp.) Free

The Emergency Planning and Community Right-To-Know Act, Section 313 Release Reporting Requirements, 1994 (28 pp.) Free

Chemical Releases and Chemical Risks, A Citizen's Guide To Risk Screening, 1989 (8 pp.) Free

Public Access to the Toxic Release Inventory (TRI): TRI Publications List, 1993 (11 pp.) Free

Title III, List of Lists - Consolidated List of Chemicals Subject To Reporting Under the Emergency Planning and Community Right-To-Know Act, 1995 Free

Common Synonyms For Chemicals Listed Under Section 313 of the Emergency Planning and Community Right-To-Know Act, 1995 Free

Also available from the EPCRA Hotline:

Chemicals, the Press and the Public: A Journalist's Guide To Reporting on Chemicals in the Community, Environmental Health Center, National Safety Council, 1989 (119 pp.) Free

Additional resources:

The Toxic Release Inventory, Environmental Democracy In Action
TRI US
202-260-1531
1992 (7 pp.) Free

Hazardous Substances In Our Environment: A Citizen's Guide to Understanding Health Risks and Reducing Exposure, U.S. EPA, 1990 (125 pp.) Free

When All Else Fails! Enforcement of the Emergency Planning and Community Right- To-Know Act, 1989 (12 pp.) Free
Risk Communication Hotline
(202) 260-5606

2.0 Accessing TRI On CD-ROM

The complete package for utilizing TRI on CD-ROM includes the CD-ROM, the Quick Reference Guide and installation instructions contained in the disc case, and this User Manual.

2.1 Installation of TRI

The installation of the CD-ROM TRI software can be performed quickly and efficiently if you follow the steps presented in the sections listed below.

2.1.1 Configuration Requirements

The following minimum configuration is needed to run the compact disc software:

- IBM or 100% IBM PC compatible personal computer (preferably a 386 or higher).
- 640K RAM (with 510K RAM available for fielded data)
- Hard disk with at least 1.5 MB disk space (required for installation)
- CD-ROM drive with CD-ROM Extensions
- MS-DOS or PC-DOS version 3.3 or above
- Color or monochrome monitor
- Printer (optional)

2.1.2 Setting Up Your CD-ROM System

This section describes how to configure a personal computer to read data from a CD-ROM device. **If your CD-ROM workstation is already setup or the workstation is being used to access other discs, please skip this section and proceed to Section 2.1.3, Installing TRI Search Software.**

There are several steps that must be performed to configure your system to begin to utilize CD-ROMs. These steps are not difficult, especially if you are comfortable with setting up directories and changing system files. Some procedures and file-naming conventions may vary from one institution to another because of differences in equipment and internal policies. The information presented here is to be used as a guide; it is not intended to provide step-by-step instructions that will work in every institution. Most organizations have designated a staff person with appropriate technical skills who can provide you with assistance, if needed.

Set-up procedures vary especially where local area networks (LANs) are in place to permit resource sharing among many users. The 1987-1993 TRI discs were designed for single-user workstations, not multi-user configurations as found on LANs. Nevertheless, TRI can be used on a network. Typically, if more than one user tries to use a disc simultaneously, the second user will receive a DOS message notifying them that the file is already in use.

2.1.2.1 Installing CD-ROM Extensions

The TRI CD-ROM, like most discs developed in recent years, is in ISO 9660 format. ISO 9660 (also called High Sierra) is a standard format that was adopted early in the development of CD-ROM technology. This format dictates a common logical file format for data on CD-ROMs that enable them to be used with a variety of different microcomputers, CD-ROM drives, and operating systems. This format, and thus most discs in use today, requires the use of software called CD-ROM Extensions. CD-ROM Extensions are usually supplied by the vendor when a CD-ROM drive is purchased.

CD-ROM Extensions provide the interface between the retrieval software developed for a particular application and the MS-DOS operating system. A program called MSCDEX.EXE prevails over the limitation in earlier versions of MS-DOS (before Version 5.0) that restricts access to devices larger in size than 32 megabytes. (This limitation is why larger hard drives are usually "partitioned" into several smaller drives.) The MSCDEX.EXE program is not required with DOS 5.0 or higher.

Another program, called a "device driver," is also provided with the CD-ROM drive. This program actually translates signals between the microcomputer and the CD-ROM drive. Device drivers are not unique to CD-ROM applications; these drivers also are required for other peripherals, such as CRTs and printers. Device driver programs can usually be identified because they are named by the manufacturer after the type of equipment for which they were developed, for example, hitachi.sys for a Hitachi CD-ROM drive.

Most computer vendors provide a simple setup program with their equipment for preparing a microcomputer to begin to recognize and interact with the CD-ROM drive. When available, use the vendor-supplied program. They are usually reliable and simple to run. However, you can configure your own system in a few steps. (The steps are essentially the same, whether they are done automatically by a program or performed manually.)

Configuring your workstation to read CD-ROMs without the aid of a set-up program requires making changes to your "autoexec.bat" and "config.sys" files, two files that provide vital instructions to the computer during the initial boot. To modify these files, you will need to use DOS or another utility for editing files.

After you have physically hooked up the hardware, the first step is installing CD-ROM Extensions (MSCDEX) and the CD-ROM device driver on your bootable disk (which in most cases is the C Drive). The name of the device driver varies from one model CD-ROM drive to another; one common practice of software developers is to name the device driver after the brand of CD-ROM drive that it supports (as previously explained). The device driver program and MSCDEX.EXE are frequently set up in separate directories. However, this practice is not universal.

The next step is to add a line to the Config.sys file to identify the device driver program. The format for this line may be as follows:

```
Device=\path\driver name/D:\driver alias/N:#
```

A typical example might be:

```
Device=\dev\hitachi.sys/D:MSCD001/n:1
```

In this example, DEV is the directory where the file - hitachi.sys - is located; hitachi.sys is the name of the device driver. MSCD001 is the driver alias provided by the manufacturer in either written instructions or the drive setup program; and the last number following the "n" represents the number of CD-ROM drives attached to that computer.

The third step is to add a line to the autoexec.bat file for running MSCDEX and assigning a letter to your CD-ROM drive. Depending on your system configuration, you may opt to setup one or more batch files to accomplish the same purpose. A line added to the autoexec.bat file will be formatted as follows:

```
\path\MSCDEX/d:driver alias/M:8/L:E
```

A typical example of this line might be:

```
\bin\MSCDEX/d:MSCD001/M:12/L:E
```

In this example, bin is the directory where the program MSCDEX is located; MSCDEX is the program commonly called CD-ROM Extensions. d:MSCD001 is the device driver alias name supplied by the manufacturer (and also listed in the config.sys file); following m: is the number of memory buffers allocated. The last letter, following L:, represents the letter used to designate the CD-ROM drive.

The final step, though simple, is nevertheless easy to overlook. You must reboot your computer in order to activate the changes that you have made to your autoexec.bat and config.sys files.

2.1.3 Installing TRI Search Software

Complete software for searching the CD-ROM is contained on each of the two discs that comprise the 1987-1993 TRI CD-ROM set. Installation, which is accomplished using a menu-driven, easy-to-use program, usually takes only a couple of minutes.

The installation procedure supplied with these discs has been enhanced to reduce RAM requirements and to allow you greater flexibility in configuring your system. For the first time, it is possible to limit users' access to DOS, in two ways: Depending on how it is installed, the retrieval software will allow (or not allow) users temporary exit to DOS while using the disc. For added security, it is also possible to set a password required to exit the TRI software and return to the DOS prompt at the end of a session. Another new option allows you to decide during installation whether to let users "add" data to CD-ROM records (in fact the data would be stored to your hard disk).

Before you begin, you may want to delete software for earlier editions of TRI since the discs that you have received contain cumulative data as well as newer, improved software. Companies are permitted by law to revise TRI reporting forms for previous years; the updated forms are included on the latest disc. Removal of outdated software from old directories is essential if you plan to use the same directory name again. (Previous software versions used TRI, REL and TRT as the default directory names.) By deleting old software, you will be able to free up several megabytes of hard disk space.

Either disc can be used to install the retrieval software that will be used to search TRI and the Chemical Substance Fact Sheets. Insert Disc One or Disc Two into the CD-ROM drive, with the label facing up.

To begin the installation, you will need to know the letter of the CD-ROM where the TRI disc is located. If you do not know the letter for the CD-ROM drive, identify it before proceeding further.

For some, the easiest way to identify the letter assigned to the CD-ROM drive is simply to try to list the directory, entering one letter after another, beginning with the letter d (e.g., c:\>dir d: <ENTER>). Another way is to view the autoexec.bat file. Return to the root directory and type:

```
c:>type autoexec.bat <ENTER>
```

Locate a line similar to:

```
\BIN\MSCDEX\D:MSCD001/M:12/L:E
```

The letter following L: at the end of the line (in this case, L:E) indicates the drive letter assigned to the CD-ROM drive. If L: is not present, your CD-ROM drive is the first letter of the alphabet not assigned to a hard disk or other storage device. The CD-ROM drive may be assigned any letter of the alphabet.

After inserting either TRI disc into the CD-ROM drive, you are ready to install selected files from it onto your hard disk. Type the CD-ROM drive letter followed by the word "install" (no quotes). For example, type:

C:\>**E:install** <ENTER>

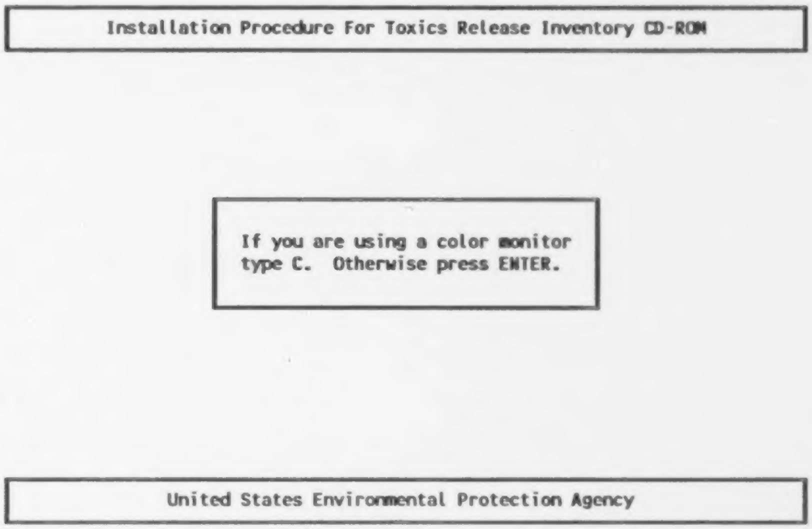
where the CD-ROM drive letter is E.

If, at any point during installation, you encounter an error message or any other indication of a problem, proceed to Section 2.1.4, Troubleshooting Software Installation.

The first installation screen will ask you to indicate whether you are using a color or monochrome monitor. (Both TRI and the Chemical Substance Fact Sheets are fully functional using a monochrome monitor.) Type C if you are using a color monitor. Press **<ENTER>** in response to the prompt if you are using a monochrome monitor.

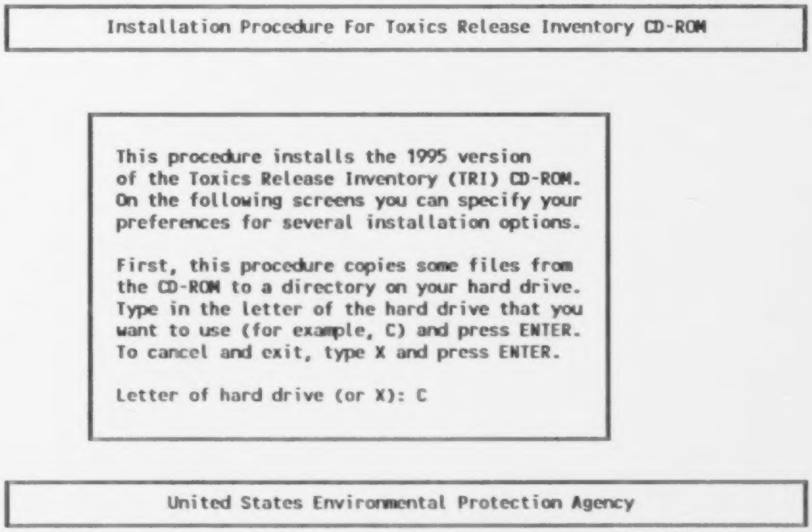
QUICK START INSTRUCTIONS FOR INSTALLING TRI

1. Insert Disc One or Two into the CD-ROM drive. (Software may be loaded from either disc.)
2. Enter the CD-ROM letter and the install command, e.g.,
   C:\>**e:install** <ENTER>.
3. Follow prompts on the installation screen:
   a. Type C <enter> or just <ENTER> to indicate whether or not you are using a color monitor.
   b. Enter the letter of the hard drive where the software will be installed and press <ENTER>.
   c. Enter a name and press <ENTER> to create a directory or press <ENTER> to use TRI as the default directory name.
   d. Using the cursor key, indicate whether or not to allow users to add data to TRI records and press <ENTER>. ("Added" data is stored on the hard disk.)
   e. Enter and verify a password to limit users' access to DOS when they are finished using the TRI CD-ROM, or press ESC to cancel the password feature. (Note: If you designate a password, it must be entered at the end of each session of CD-ROM use.)
   f. Indicate whether or not to allow Temp Exit to DOS while using the CD-ROM and press <enter>.
4. The system will respond by copying files to the hard drive (up to 31 files, based on the choices made above).
5. Type TRI at the DOS prompt (e.g., C:\TRI>TRI) to begin using the CD-ROM.



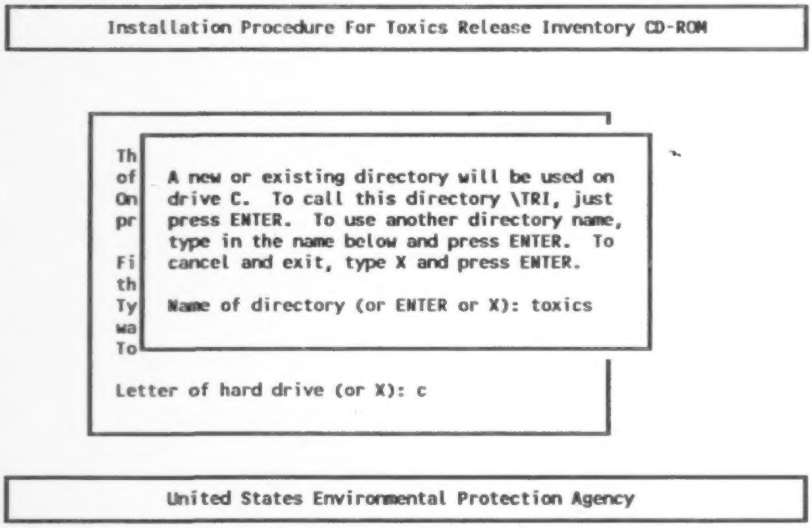
```
Installation Procedure For Toxics Release Inventory CD-ROM

If you are using a color monitor
type C.  Otherwise press ENTER.

United States Environmental Protection Agency
```

The screen below asks you to identify the letter of the hard disk where you would like to install the retrieval software. (Depending on the choices that you make during installation, about 1.5 K of hard disc space will be needed to install TRI.) Enter the letter of the hard drive and press **<ENTER>**.



```
Installation Procedure For Toxics Release Inventory CD-ROM

This procedure installs the 1995 version
of the Toxics Release Inventory (TRI) CD-ROM.
On the following screens you can specify your
preferences for several installation options.

First, this procedure copies some files from
the CD-ROM to a directory on your hard drive.
Type in the letter of the hard drive that you
want to use (for example, C) and press ENTER.
To cancel and exit, type X and press ENTER.

Letter of hard drive (or X): C

United States Environmental Protection Agency
```

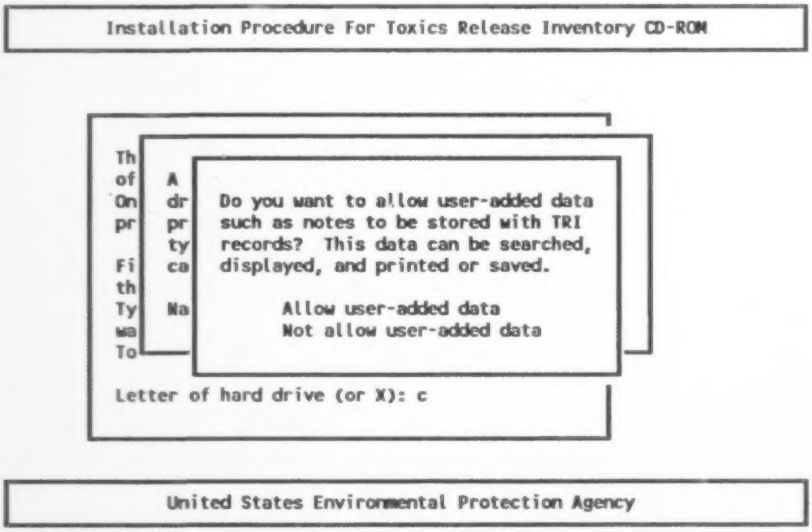
The next screen allows you to choose the name of the directory where you would like the retrieval software to be installed. If you wish to designate a directory, enter the name and press <enter> (e.g., c:\>**toxics** **<ENTER>**). If you prefer, you may accept "TRI" as the default directory name by just pressing **<ENTER>** instead.



```
          Installation Procedure For Toxics Release Inventory CD-ROM

   Th
   of   A new or existing directory will be used on
   On   drive C.  To call this directory \TRI, just
   pr   press ENTER.  To use another directory name,
        type in the name below and press ENTER.  To
   Fi   cancel and exit, type X and press ENTER.
   th
   Ty   Name of directory (or ENTER or X): toxics
   wa
   To

   Letter of hard drive (or X): c

               United States Environmental Protection Agency
```

The next screen allows you to choose whether or not you want TRI users to be able to "add" data to records from TRI. As an option, users would be able fill two fields called User Added Data that would be linked (unless later deleted) to that TRI record. The additional data would actually be written to the hard drive in the directory where the retrieval software was loaded. From then on, each time a user called up that record from the CD-ROM, the associated User Added Data would also be retrieved from the hard drive and displayed at the end of the record. (See Chapter 4.)

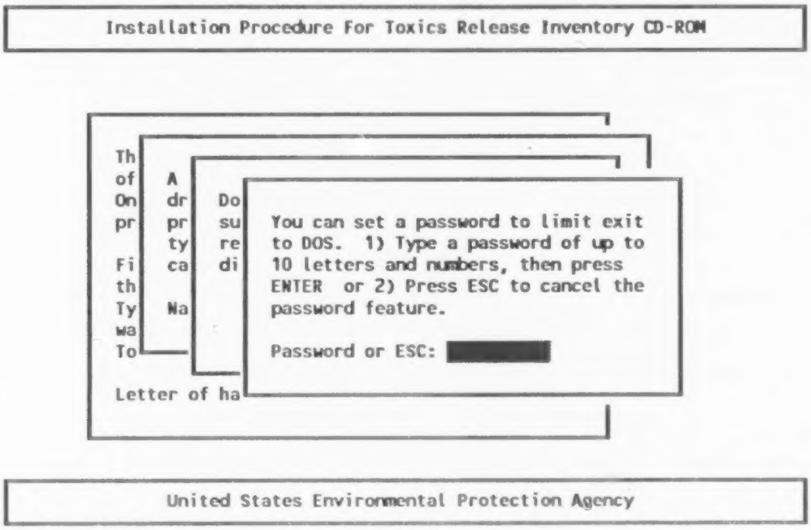
If you wish to allow User Added Data, highlight the first option shown and press **<ENTER>**. To restrict users from being able to write User Added Data to your hard drive, highlight "Not allow user-added data" and press **<ENTER>**.



```
          Installation Procedure For Toxics Release Inventory CD-ROM

   Th
   of   A
   On   dr   Do you want to allow user-added data
   pr   pr   such as notes to be stored with TRI
        ty   records?  This data can be searched,
   Fi   ca   displayed, and printed or saved.
   th
   Ty   Na         Allow user-added data
   wa              Not allow user-added data
   To

   Letter of hard drive (or X): c

               United States Environmental Protection Agency
```

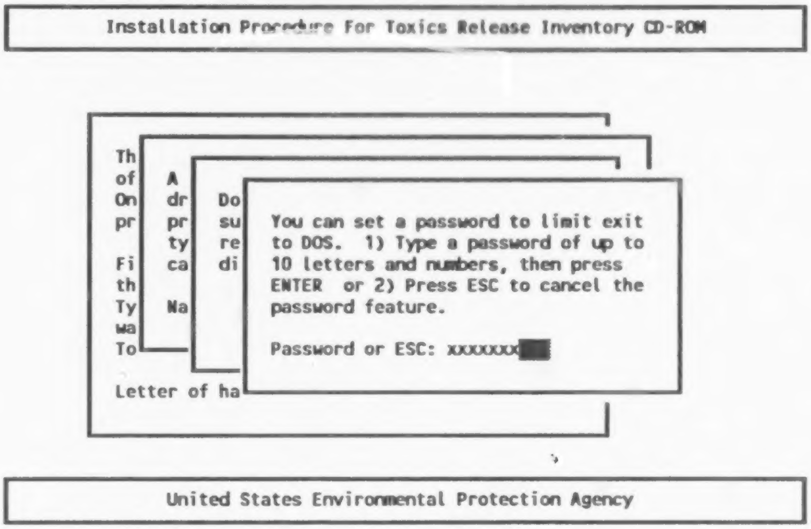
The next segment of the installation procedure allows you the option of designating a password that would be required to <u>exit</u> from the CD-ROM. The purpose of this security feature is to prevent unauthorized access to DOS upon completion of a TRI CD-ROM session. This capability is often helpful where public access is permitted, such as in libraries. Of course, there are other effective ways, like shell programs, that can also limit DOS access at the end of a session. Remember, if you choose an exit password, someone will need to enter it at the conclusion of each session before the workstation can be used for another purpose. (If you later forget the password that you designated, call TRI User Support (202 260-1531) for assistance, or reinstall the software.)

If you do not wish to create an exit password, press **<ENTER>** in response to the prompt shown below and skip to the next part of the installation procedure. Otherwise, enter a password containing up to 10 letters and numbers and press **<ENTER>**.



```
Installation Procedure For Toxics Release Inventory CD-ROM

You can set a password to limit exit
to DOS.  1) Type a password of up to
10 letters and numbers, then press
ENTER  or 2) Press ESC to cancel the
password feature.

Password or ESC:

United States Environmental Protection Agency
```

As you enter the password, the letters will be masked by x's, as shown below:


Installation Procedure For Toxics Release Inventory CD-ROM

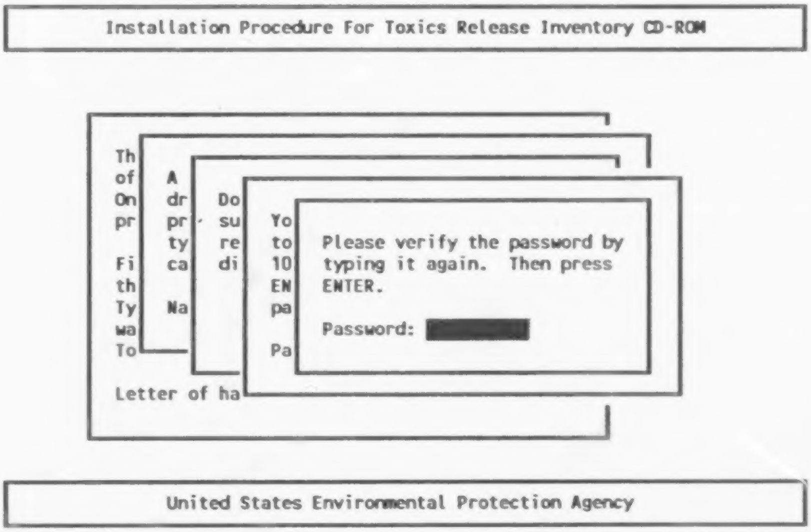
You can set a password to limit exit to DOS. 1) Type a password of up to 10 letters and numbers, then press ENTER or 2) Press ESC to cancel the password feature.

Password or ESC: xxxxxxx

United States Environmental Protection Agency

Th
of
On
pr
Fi
th
Ty
wa
To
A
dr
pr
ty
ca
Na
Do
su
re
di
Letter of ha

The system will respond with a screen asking you to re-enter the same password for verification:


Installation Procedure For Toxics Release Inventory CD-ROM

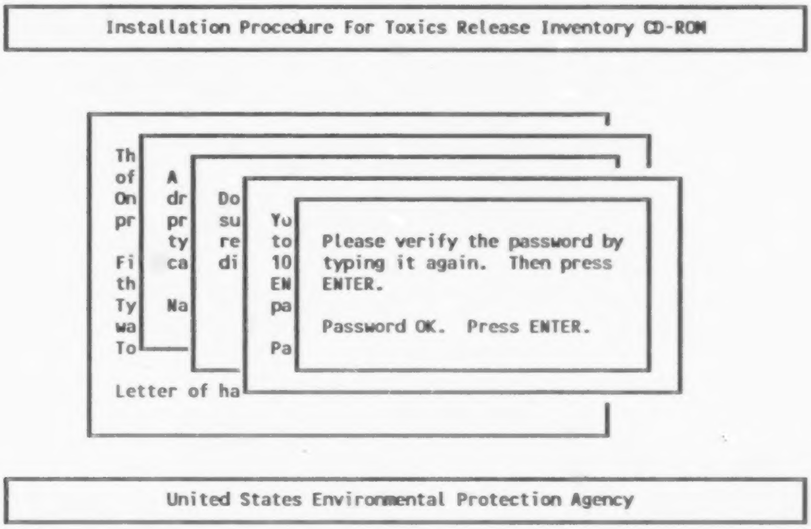
Please verify the password by typing it again. Then press ENTER.

Password:

United States Environmental Protection Agency

Th
of
On
pr
Fi
th
Ty
wa
To
A
dr
pr
ty
ca
Na
Do
su
re
di
Yo
to
10
EN
pa
Pa
Letter of ha

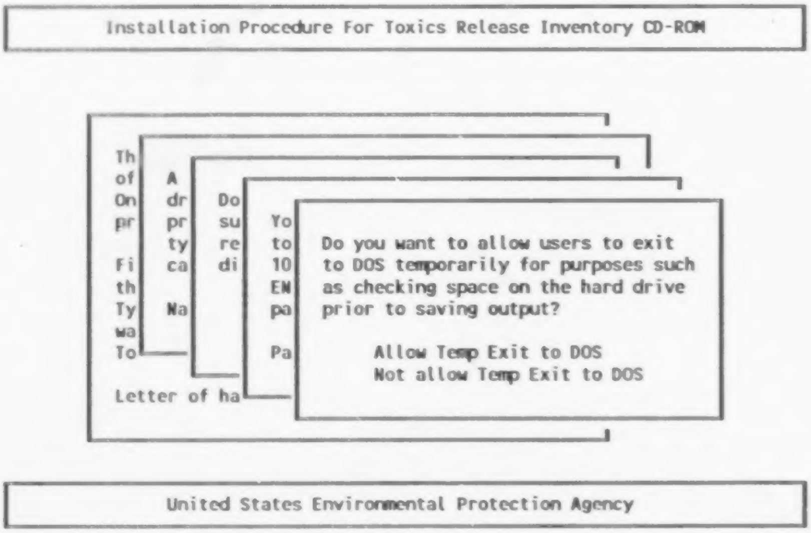
The system will either accept the password as entered the second time (if it matches exactly), or you will receive a prompt asking you to create and verify a new password.



```
Installation Procedure For Toxics Release Inventory CD-ROM

Th
of  A
On  dr  Do
pr  pr  su  Yo
    ty  re  to  Please verify the password by
Fi  ca  di  10  typing it again.  Then press
th          EN  ENTER.
Ty  Na      pa
wa              Password OK.  Press ENTER.
To          Pa

Letter of ha

United States Environmental Protection Agency
```

The final choice that you will make during installation is whether or not to allow users temporary access to DOS while still using the TRI CD-ROM. Sometimes access to DOS is useful to perform tasks like creating directories or verifying file names before exporting data. However, in public settings, access to DOS is often blocked for security reasons, as mentioned earlier.

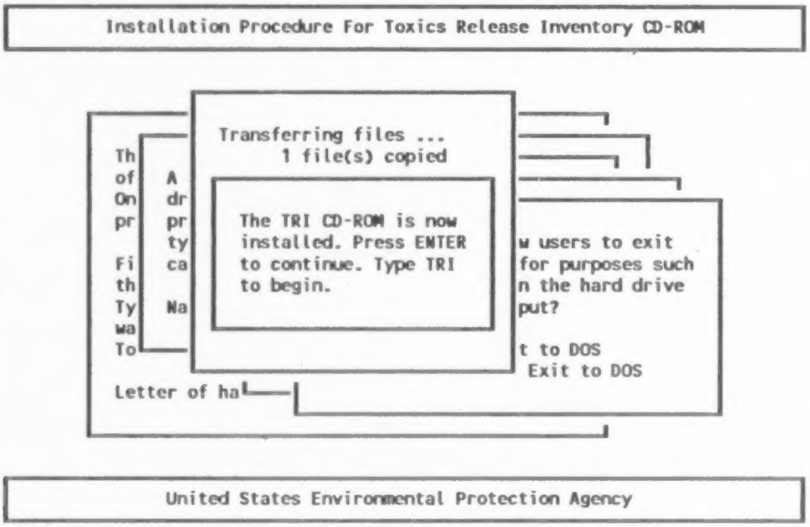
Using the cursor key, highlight your choice, as shown below, and press **<ENTER>**.



```
Installation Procedure For Toxics Release Inventory CD-ROM

Th
of  A
On  dr  Do
pr  pr  su  Yo
    ty  re  to  Do you want to allow users to exit
Fi  ca  di  10  to DOS temporarily for purposes such
th          EN  as checking space on the hard drive
Ty  Na      pa  prior to saving output?
wa
To          Pa       Allow Temp Exit to DOS
                     Not allow Temp Exit to DOS
Letter of ha

United States Environmental Protection Agency
```

The system will proceed with installation by copying a number of files to your hard disk. (The number of files will vary between 24 and 31, depending on whether you chose to allow User Added Data, designated a password, etc.)

When all of the files have been copied successfully, a message indicating that installation has been completed. The message also indicates the name of the directory where the software was installed appears on the screen.



```
Installation Procedure For Toxics Release Inventory CD-ROM

         Transferring files ...
              1 file(s) copied
Th
of  A
On  dr
pr  pr     The TRI CD-ROM is now
    ty     installed. Press ENTER      w users to exit
Fi  ca     to continue. Type TRI       for purposes such
th         to begin.                   n the hard drive
Ty  Na                                 put?
wa
To                                     t to DOS
                                        Exit to DOS
Letter of ha

United States Environmental Protection Agency
```

If you wish to begin using TRI immediately or to check that the software is properly installed, type TRI at the DOS prompt (e.g., c:\TOXICS>**TRI**,) and press **<ENTER>**. The system will respond by displaying the main menu. See Chapter 4.)

2.1.4 Troubleshooting Software Installation

In most cases, software installation is trouble-free. In a few cases, however, difficulties may arise. This section is designed to help you identify and remedy the most common problems. For convenience, it is organized by symptom. Error messages are shown in bold print to help you locate them quickly.

CDR101:Not ready error reading drive [CD-ROM drive letter]
Abort, Retry, Fail?

The first item to check for this error is whether the TRI CD is properly inserted in the drive with the label facing up. This error may occur during installation or anytime someone is preparing to use the CD-ROM.

A more difficult problem to resolve is when your system is not configured properly. If you also have trouble reading a CD-ROM other than TRI when you list the directory, an improper configuration is likely the problem. If you think your system is configured improperly, examine the autoexec.bat, config.sys, and other files that are created to run the CD-ROM drive. If you cannot detect the problem, seek assistance from a systems expert.

Although it is possible, it is highly unlikely that the CD-ROM itself is faulty unless the product was damaged following its manufacture.

Bad Command or File Name

If this error occurs during the initial installation, check for typographical errors in the way the command was entered. If the error occurs during installation or when you are trying to use the TRI database, the computer is reading from a subdirectory (e.g., TRIFACTS) rather than the root directory of the CD-ROM. To remedy the problem, change to the root directory of the CD-ROM. (Enter the letter for the CD-ROM drive followed by a colon. Then, type cd\ and press **<ENTER>**.)

Invalid Drive Specification

The CD-ROM drive was not turned on until after the PC. Turn on the PC after turning on the CD-ROM drive.

Invalid Drive Letter

The letter that you entered to represent the CD-ROM drive does not agree with the system configuration that is presently active. Verify the letter assigned to the CD-ROM drive by checking the autoexec.bat file or listing the CD-ROM directory. Try rebooting your system if the autoexec.bat file appears to be correct but there is a chance that it was changed since the last boot.

File Not Found

It is normal for this message to flash on the screen momentarily the first time that you use the disc following software installation. (Additional files are created automatically as soon as you begin using the CD-ROM.) If the message recurs during subsequent use, it may mean that installation was interrupted or did not complete successfully. The number of files transferred to the hard drive may vary (between 24 and 31 files), depending on how the software was installed i.e., whether DOS access and user added data were allowed. If a problem occurs resulting in the message File Not Found, the easiest solution may be to repeat the installation procedure.

Display shows something other than TRI Installation Screen

This error may occur if the CD-ROM reader is reading from a directory rather than the root directory of the TRI CD-ROM during the installation process. To remedy the problem, change to the root directory of the CD-ROM. (Enter the letter for the CD-ROM drive followed by a colon. Then, type cd\ and press **<ENTER>**.)

### [#] Additional Bytes of Available Memory Required To Run KAware2 Press ENTER to Exit KAware2

Out of Memory: This Application requires 0 Additional Bytes of Free Memory

These messages will appear if your system does not have enough room to load the software and TRI records into memory to allow you to retrieve the TRI data. About 430K available memory is required to load the Chemical Substance Fact Sheets. Approximately 507K of memory is required for the TRI data base. Although the error message says that no additional bytes of free memory are needed, additional memory is required. The message instructs you to press **<ENTER>** to return to DOS to investigate the memory problem, however, when you press **<ENTER>**, you will not return to the DOS prompt. Instead, you will return to the **DATA SELECTION MENU**.

Most microcomputers are configured with at least 640K of Random Access Memory (RAM). Memory is the area where your computer temporarily stores data and instructions it needs to execute that tasks you have requested. (Don't confuse memory with hard disk space usually measured in megabytes which provides longer-term data storage.) Some of your computer's memory may be used by DOS or other programs loaded on your equipment. To find out how much memory is actually available, at the C prompt in the root directory, type:

```
c:\>chkdsk
```

Scan the display; the last line tells you how many bytes of memory are free.

2.1.5 If You Need More Memory...

One of the most common problems that users experience during installation occurs when insufficient random access memory (RAM) is available to load the files. As noted above, 507K of RAM is required to successfully install the TRI software. (It is important to distinguish between RAM, required by DOS applications such as the TRI discs, and other types of memory. See the sidebar on the following page for a brief description.) If you are currently experiencing problems due to memory limitations, it is only going to get worse as more multimedia and audio discs are introduced. You may want to consider upgrading the memory or modernizing your CD-ROM workstation. If you are considering enhancing your existing system, you may wish to speak to someone knowledgeable in this area before proceeding.

There are, however, several steps that you can take to maximize the RAM available without upgrading equipment. The easiest method requires use of DOS 5.0 or higher, which allows you to make use of memory in several new ways. For example, it allows you to utilize part of the upper which was restricted from use unless you purchased a separate memory management program. In addition, you can transfer actual DOS programs from conventional memory to the high memory area, thus freeing up a larger portion of the precious 640K conventional memory.

Another possibility is to identify and discontinue use of any unnecessary "terminate and stay resident" (TSR) programs that you may be using. All computer software requires the use of some memory while the computer is in use. TSR programs are routines that continue to occupy memory even if these programs are not active. Often such programs are difficult to identify and you may need assistance.

Here are two steps you might take to free-up memory space occupied by TSRs:

1) Reboot your system before using the TRI CD-ROM. Some application software, for example, spreadsheets, word processors, etc., may leave a "part" of the program in memory, even though you are no longer using the program. By rebooting your system, you will rid the memory of TSR routines remaining from software used earlier.

2) Change your autoexec.bat file to eliminate TSR programs that are activated as soon as you turn your computer on. A common example of TSRs is a "shell" programs to display a menu instead of the DOS prompt when you first boot the computer or allow your numeric keypad to function like a calculator. If you modify your autoexec.bat file, be sure to reboot your computer to activate any changes you have made.

TYPES OF COMPUTER MEMORY

The 640K (or sometimes less) memory with which you are most familiar is known as conventional memory, also called random access memory (RAM). Conventional memory can be used in many ways, including loading and executing programs, for DOS and device drivers, and temporarily storing data. DOS applications, like the TRI CD-ROM, require access to varying amounts of RAM in order to run. (TRI requires 510K RAM.) Most PCs in use today also have an additional 384K memory (transparent to the user) that increases memory from 640K to 1 MB. Use of this space, known as "upper memory," is somewhat restricted. For example, it is not accessible to most programs and earlier versions of DOS (before 5.0).

Expanded memory, developed to overcome the 640K DOS barrier (before DOS 5.0), requires installation of a card in an expansion slot on your PC. Expanded memory allows you to use conventional memory more efficiently by swapping data from expanded memory in and out of conventional memory very quickly in 64K blocks. Thus, your computer is "fooled" into using programs that are actually stored on the expansion card.

Extended memory, developed after expanded memory was widely available, uses a completely different approach. This is an area above 1 MB (up to 32 MB) that is accessible from a chip on the motherboard. Extended memory is only available on 80286 and faster machines. Some programs, such as Windows and Lotus 1-2-3, can fully utilize extended memory just as though it was part of the conventional 640K.

There is one other type of memory - high memory - which is the first 64K of extended memory.

Another alternative is to reduce the number of files allocated in your config.sys file. The config.sys file, read automatically by the computer when you boot, instructs the computer on how to allocate some of its memory. The config.sys file describes the number of files that can be opened at one time with the files command. For example, files=10 means that a maximum number of ten files may be open at one time. Usually the minimum number of files is between six and ten, because DOS requires five files for its use. Reboot the computer after changing the config.sys file.

You also can reduce the number of memory buffers. DOS uses disk buffers to store data when reading from and writing to a disk. Each buffer requires 528 bytes of memory. The number of buffers you allocate depends on the type of applications you use and your hardware configuration. Check the documentation or contact your system administrator to determine the minimum number of buffers for your situation. If you modify the config.sys file, reboot the system.

2.2 TRI CD-ROM Structure

The CD-ROM version of TRI consists of three separate and distinct options and features: the Toxics Release Inventory, Fact Sheets, and performing calculations. These options and features will be discussed in the next sections.

2.2.1 Chemical Substance Fact Sheets

In addition to the TRI itself, the CD-ROM also contains Fact Sheets that provide information about health, safety and ecological data on TRI chemicals. You might use this file after searching for information in the TRI itself (discussed below) to learn more about the effects and to better understand the chemicals that have been identified. The fact sheets data base is provided on both Disc 1 and Disc 2, for your convenience. For more information, see Chapter 3.

2.2.2 Toxics Release Inventory

This set of two CD-ROMs cumulate several years of the Toxics Release Inventory, dating back to the inception of the program in 1987. Disc One contains TRI submissions for reporting years 1987-1990; Disc Two contains TRI reports for 1991-1993. On each CD-ROM, TRI records are broken down into two files, called RELEASES and TREATMNT:

> The RELEASES file is used when requesting comprehensive facility identification information. This file contains total amounts of chemicals released to the mediums (air, land, water) and publicly owned treatment works (POTWs). It can be used to display summary of releases, e.g., searching for facility and chemical information for ABC Manufacturing Company, or the name and addresses of off-site locations in Houston, Texas where chemical wastes are shipped.

The TREATMNT file is used to search for data on waste treatment methods and efficiency, and waste minimization.

For more information about searching the RELEASES and TREATMNT files, see Chapter 4.

2.2.3 Calculation Feature (KASTAT)

KASTAT is a feature of TRI that takes sets that have been created and calculates the sum totals of fields that have been selected. For more information, see Chapter 5.

2.3 Readme Files

There are several "readme" files that provide documentation for the database and referrals to State and Regional contacts. These files can be viewed and printed directly from the CD-ROM. These files are:

README.NOW: Describes TRI and the contents of these discs more fully;

FIELDS.TRI: Contains descriptions of all the data fields including codes and translation of coded information.

REGIONS.EPA: Contains the names, addresses, and telephone numbers of the 10 Federal EPA Regional contacts.

SIC_CODE: Contains the four-digit Standard Industrial Classification codes for 20-39 and the code descriptions.

STATES: Contains the names, addresses, and telephone numbers of the State and Territorial TRI contacts.

2.4 Accessing the Toxics Release Inventory

In order to access TRI on the CD-ROM:

1. Turn on the CD-ROM drive and the personal computer.

   NOTE: The CD-ROM drive must be turned on before or at the same time as the PC.

2. Insert one of the two TRI compact discs (CD) into the CD-ROM drive.

3. Make sure that you are logged onto the hard drive where the TRI retrieval software was loaded. If not, type **C: <ENTER>** (or the appropriate letter for your configuration).

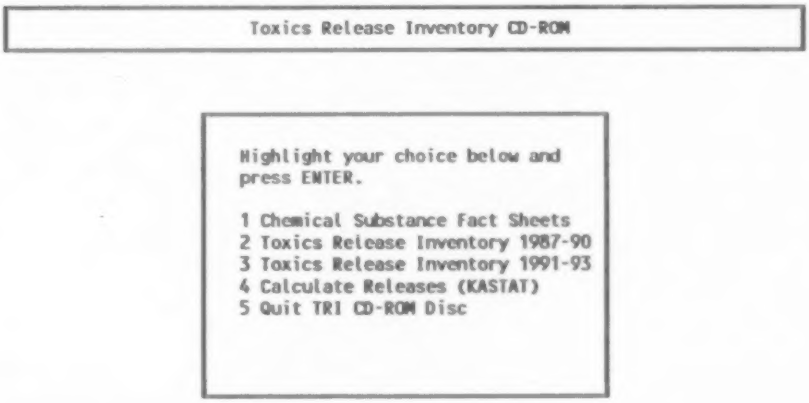
4. Access the directory where the TRI CD-ROM software was loaded (e.g., TRI, the default directory name supplied by the installation module):

   CD TRI <ENTER>

5. To launch TRI, at the subdirectory DOS prompt (e.g., C:\TRI>), type:

   TRI <ENTER>

   The first screen you will see is the Data Base Selection menu:



```
Toxics Release Inventory CD-ROM

Highlight your choice below and
press ENTER.

1 Chemical Substance Fact Sheets
2 Toxics Release Inventory 1987-90
3 Toxics Release Inventory 1991-93
4 Calculate Releases (KASTAT)
5 Quit TRI CD-ROM Disc
```

6. Press the arrow keys to move to the selection of your choice or press the corresponding number and press **<ENTER>** to indicate your selection.

Each of the selections will be discussed in the next several chapters. With the selection of Option 5, Quit TRI CD-ROM Disc, you will leave the TRI software and return to the DOS prompt and the TRI directory. To re-enter TRI, type TRI (see #5 above) and proceed with the instructions.

2.5 Special Keys

The TRI CD-ROM software employs the use of many specials keys to ease your use of the software. These special keys are described below.

Arrows - Allow you to move up, down, left and right in menus, screens, and records.

Home/End - Allows you to move to the top of page with HOME and to the bottom of page with END. The combination of the CTRL and HOME keys pressed simultaneously moves you to the first record in a set. The combination of the CTRL and END keys pressed simultaneously moves you to the last record in a set.

PgUp/PgDn - Allows you to move backward or forward through a menu or display, one page at a time.

ESC - allows you to perform the following functions:

- Acts as a backup key to return you to the previous step
- Will abort a search
- Will abort a save or load of a set list
- Returns you to the Title Screen when the function keys 1-5 are open.

Ctrl - In combination with another letter key hit simultaneously will assist in performing a variety of options.

Alt - In combination with another letter key hit simultaneously will assist in performing a variety of options.

NOTE: To remove a pull-down menu associated with a function key option, press the function key for that option and the pull-down menu will toggle off. Press the same function key to toggle the pull-down menu back on.

2.6 Printing Files

You can print a record that you are viewing on the screen with the *Print Current Record* option. In addition, you can print a set of records that you have created. These options will be discussed in Chapters 3 & 4.

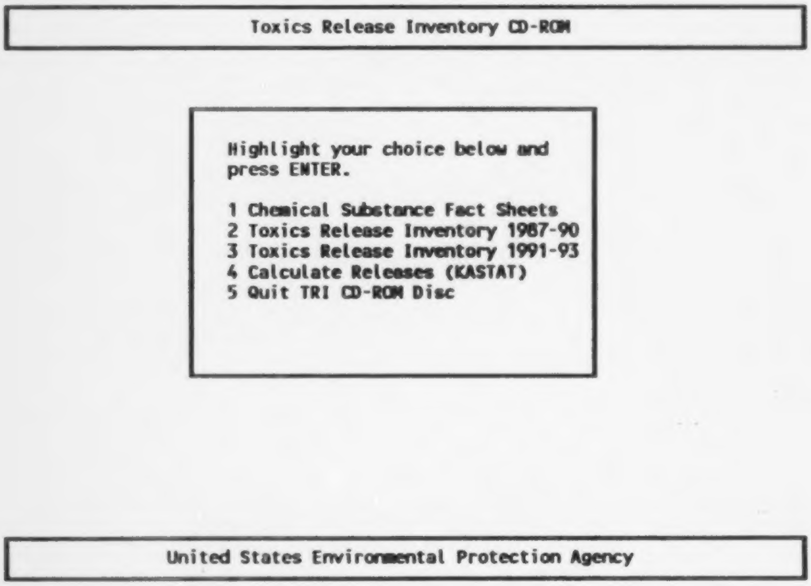
3.0 Chemical Substance Fact Sheets

Fact sheets supplement the environmental release data on chemicals in TRI with information related to the health and ecological effects as well as safety and handling of the chemicals. There is a fact sheet for most TRI chemicals, except when categories of chemicals are grouped together for TRI reporting (e.g., lead compounds). Designed for a lay audience, they represent scientifically accepted information in non-technical language. The data may be especially useful to workers, employers, community residents, and health professionals.

It is especially useful to review the Fact Sheets after identifying chemicals of interest by searching the TRI Fielded Database. Text on health, safety, and ecological data is displayed along with the common name and CAS number.

For your convenience, Chemical Substance Fact Sheets are provided on both TRI discs, and can be accessed from the main menu on Disc One or Disk Two.

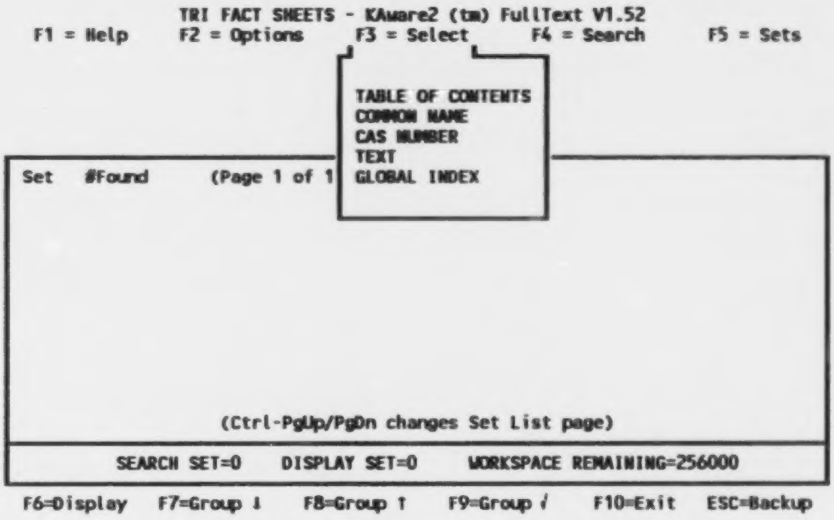
Press **<ENTER>** to Select #1, **Chemical Substance Fact Sheets**, from the **DATA BASE SELECTION MENU**.



```
Toxics Release Inventory CD-ROM

Highlight your choice below and
press ENTER.

1 Chemical Substance Fact Sheets
2 Toxics Release Inventory 1987-90
3 Toxics Release Inventory 1991-93
4 Calculate Releases (KASTAT)
5 Quit TRI CD-ROM Disc

United States Environmental Protection Agency
```

While the TRI Fact Sheets are being loaded, the message, "Loading KAware2 with E:\TRIFACTS\FACTS - Please Wait" will be displayed. (The drive designation - E: - in this message will vary according to the letter assigned to the CD-ROM.) The next screen to be displayed is the **TRI FACT SHEETS TITLE SCREEN**.

Press **<ENTER>** to continue. The **TRI FACT SHEETS MAIN MENU** (with F3 = Select, highlighted) will appear.



```
                  TRI FACT SHEETS - KAware2 (tm) FullText V1.52
F1 = Help         F2 = Options     F3 = Select      F4 = Search      F5 = Sets

                                   TABLE OF CONTENTS
                                   COMMON NAME
                                   CAS NUMBER
                                   TEXT
Set   #Found        (Page 1 of 1   GLOBAL INDEX



                 (Ctrl-PgUp/PgDn changes Set List page)
       SEARCH SET=0     DISPLAY SET=0     WORKSPACE REMAINING=256000
F6=Display   F7=Group ↓   F8=Group ↑   F9=Group √   F10=Exit   ESC=Backup
```

3.1 Overview of Conducting A Search

To conduct a search of data contained in Fact Sheets, there are several simple steps. You will need to SELECT the data elements for the specific information you need; SEARCH for specific values related to those data elements; DISPLAY the data; and PRINT the date for later viewing or DOWNLOAD (export) the data to other software formats. Additional information on conducting a search is provided in Section 3.3, Conducting A Search For Fact Sheets.

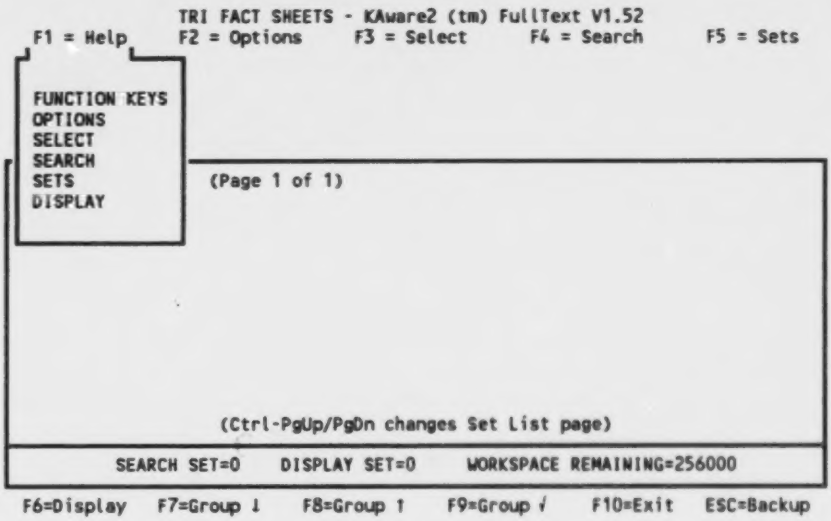
3.2 Function Key Options

Several options in the form of function key selections are displayed on the top and bottom of the screen. Some of these options have pull-down menus associated with the option. These options are as follows.

NOTE: To remove a pull-down menu associated with a function key option, press the function key for that option and the pull-down menu will toggle off. Press the same function key to toggle the pull-down menu back on.

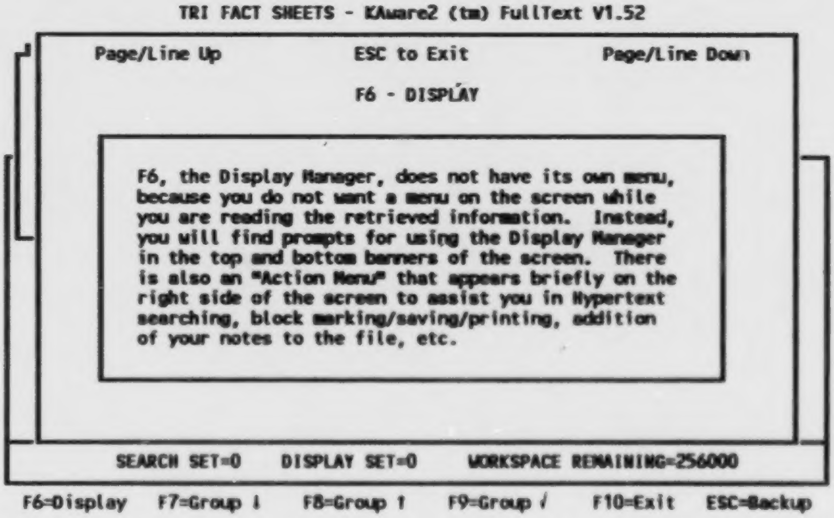
3.2.1 F1 = HELP Key

F1 = Help - This option provides context sensitive HELP for several of the function key selections. The HELP pull-down menu is displayed below:



```
                  TRI FACT SHEETS - KAware2 (tm) FullText V1.52
F1 = Help      F2 = Options      F3 = Select      F4 = Search      F5 = Sets

FUNCTION KEYS
OPTIONS
SELECT
SEARCH
SETS                (Page 1 of 1)
DISPLAY

                    (Ctrl-PgUp/PgDn changes Set List page)

       SEARCH SET=0     DISPLAY SET=0      WORKSPACE REMAINING=256000
F6=Display   F7=Group ↓    F8=Group ↑    F9=Group √    F10=Exit   ESC=Backup
```

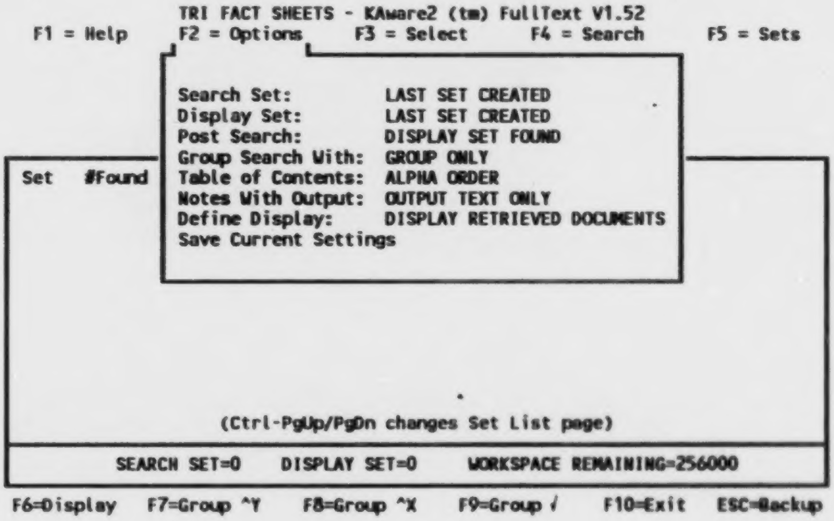
The HELP option is available at any time while you are in the TRI Fact Sheets by pressing the F1 key. Use the PgUp/PgDn keys to move within the HELP text. A HELP example is displayed below:



```
              TRI FACT SHEETS - KAware2 (tm) FullText V1.52
     Page/Line Up            ESC to Exit            Page/Line Down
                             F6 - DISPLAY

        F6, the Display Manager, does not have its own menu,
        because you do not want a menu on the screen while
        you are reading the retrieved information.  Instead,
        you will find prompts for using the Display Manager
        in the top and bottom banners of the screen.  There
        is also an "Action Menu" that appears briefly on the
        right side of the screen to assist you in Hypertext
        searching, block marking/saving/printing, addition
        of your notes to the file, etc.

      SEARCH SET=0    DISPLAY SET=0    WORKSPACE REMAINING=256000
F6=Display  F7=Group ↓  F8=Group ↑  F9=Group √  F10=Exit  ESC=Backup
```

3.2.2 F2 = OPTIONS Key

<u>F2 = Options</u> - This option allows you to access the settings for the search, display, and output of information. The OPTIONS pull-down menu is displayed below:

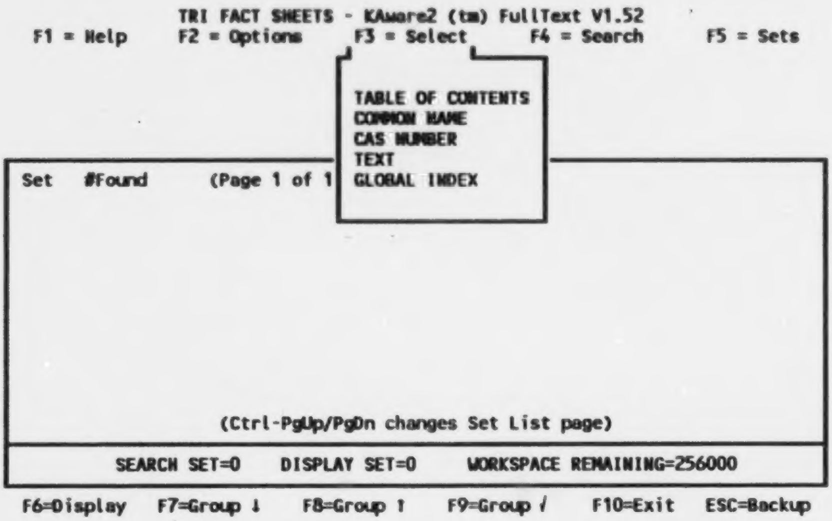


```
              TRI FACT SHEETS - KAware2 (tm) FullText V1.52
F1 = Help     F2 = Options     F3 = Select     F4 = Search     F5 = Sets

              Search Set:           LAST SET CREATED
              Display Set:          LAST SET CREATED
              Post Search:          DISPLAY SET FOUND
              Group Search With:    GROUP ONLY
 Set   #Found Table of Contents:    ALPHA ORDER
              Notes With Output:    OUTPUT TEXT ONLY
              Define Display:       DISPLAY RETRIEVED DOCUMENTS
              Save Current Settings

                  (Ctrl-PgUp/PgDn changes Set List page)
      SEARCH SET=0    DISPLAY SET=0    WORKSPACE REMAINING=256000
F6=Display  F7=Group ^Y  F8=Group ^X  F9=Group √  F10=Exit  ESC=Backup
```

When the cursor is on a specific selection in the OPTIONS menu, press **<ENTER>** to toggle through all of the choices for that selection. As an example, for **Search Set**, *Last Set Created* is displayed. By pressing **<ENTER>**, the other choices, *Selected Set* and *Entire Document*, also are displayed. When the desired choice is displayed, press the up or down arrow to move to another selection within the OPTIONS menu. To save your selections, use the down arrow to **Save Current Settings**. Press **<ENTER>**. The new settings will now become the current settings until they are changed. Press F1 (HELP) when the pull-down menu for OPTIONS is displayed to view the effects of your selection.

3.2.3 F3 = SELECT Key

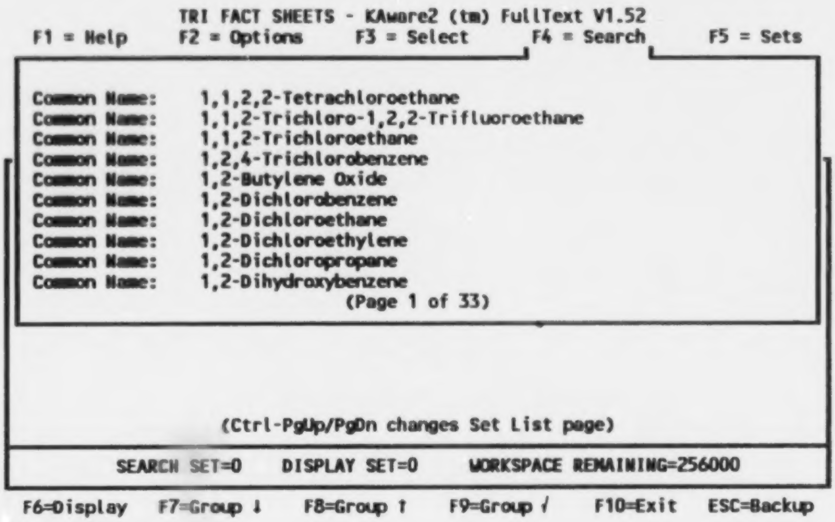
F3 = Select - This option displays all the fields used to search for data in the TRI Fact Sheets. The SELECT menu is displayed below:



```
                 TRI FACT SHEETS - KAware2 (tm) FullText V1.52
  F1 = Help      F2 = Options     F3 = Select       F4 = Search       F5 = Sets

                                  TABLE OF CONTENTS
                                  COMMON NAME
                                  CAS NUMBER
                                  TEXT
 Set   #Found        (Page 1 of 1 GLOBAL INDEX

                      (Ctrl-PgUp/PgDn changes Set List page)
          SEARCH SET=0     DISPLAY SET=0     WORKSPACE REMAINING=256000
 F6=Display   F7=Group ↓    F8=Group ↑    F9=Group √    F10=Exit    ESC=Backup
```

NOTE: The choices in the pull-down menu for F3 = Select are tied directly to the function, F4 = Search. Since this option is the core of the searching capabilities for the TRI Fact Sheets, each of the choices will be described below to assist you in its usage.

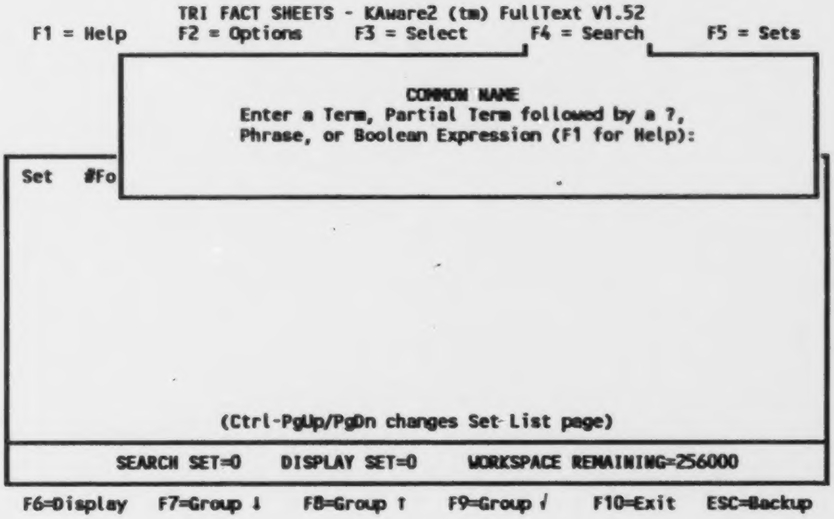
<u>TABLE OF CONTENTS</u> - This choice provides a listing which displays all of the common names of chemicals in alphabetic order (or the order that is indicated in the Table of Contents selection under the F2 = Options choice). Chemical names preceded by numbers sort before chemicals that begin with an alphabetic character (see examples on sample screen shown below). There are 33 screens of chemical common names. Use the **<PGUP>** and **<PGDN>** keys to browse through the list of chemicals sequentially. When you have located the common name that you need, press **<ENTER>**. The <u>Table of Contents</u> only searches the chemical common name field. After selecting a name, the record is displayed but no set is created.



```
                TRI FACT SHEETS - KAware2 (tm) FullText V1.52
  F1 = Help     F2 = Options     F3 = Select     F4 = Search      F5 = Sets

  Common Name:     1,1,2,2-Tetrachloroethane
  Common Name:     1,1,2-Trichloro-1,2,2-Trifluoroethane
  Common Name:     1,1,2-Trichloroethane
  Common Name:     1,2,4-Trichlorobenzene
  Common Name:     1,2-Butylene Oxide
  Common Name:     1,2-Dichlorobenzene
  Common Name:     1,2-Dichloroethane
  Common Name:     1,2-Dichloroethylene
  Common Name:     1,2-Dichloropropane
  Common Name:     1,2-Dihydroxybenzene
                              (Page 1 of 33)



                 (Ctrl-PgUp/PgDn changes Set List page)
        SEARCH SET=0    DISPLAY SET=0     WORKSPACE REMAINING=256000
  F6=Display   F7=Group ↓    F8=Group ↑    F9=Group √     F10=Exit   ESC=Backup
```

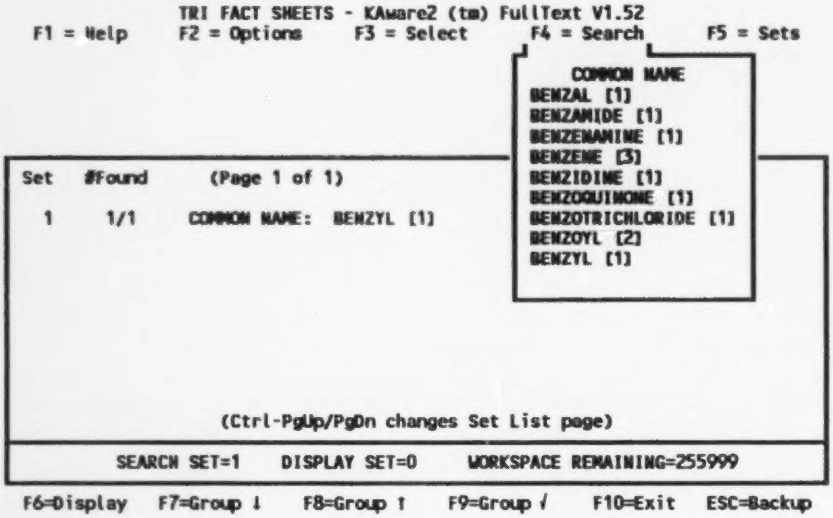
<u>COMMON NAME</u> - This choice also allows you to search by common chemical name, but provides greater flexibility in searching. It allows you to type in a term, partial term (followed by a question mark (?)), phrase, or boolean expression to locate a common chemical name. For chemical names that begin with numbers, omit the numbers when searching. (For example, search 1,1,2,2 - Tetrachlorethane by entering Tetrachlorethane.) Only the common name field will be searched, not the text of the Fact Sheet. Unlike using the Table of Contents to search by common chemical name, this option will result in creation of a search set.

NOTE: It is possible to search the Common Name field using boolean expressions, however, it is not the most effective way to search by chemical name. Instead, type a partial term followed by a question mark (e.g., chlor?) to identify variant spellings or similar chemical names.



```
TRI FACT SHEETS - KAware2 (tm) FullText V1.52

COMMON NAME
Enter a Term, Partial Term followed by a ?,
Phrase, or Boolean Expression (F1 for Help):

(Ctrl-PgUp/PgDn changes Set List page)

SEARCH SET=0    DISPLAY SET=0     WORKSPACE REMAINING=256000
```

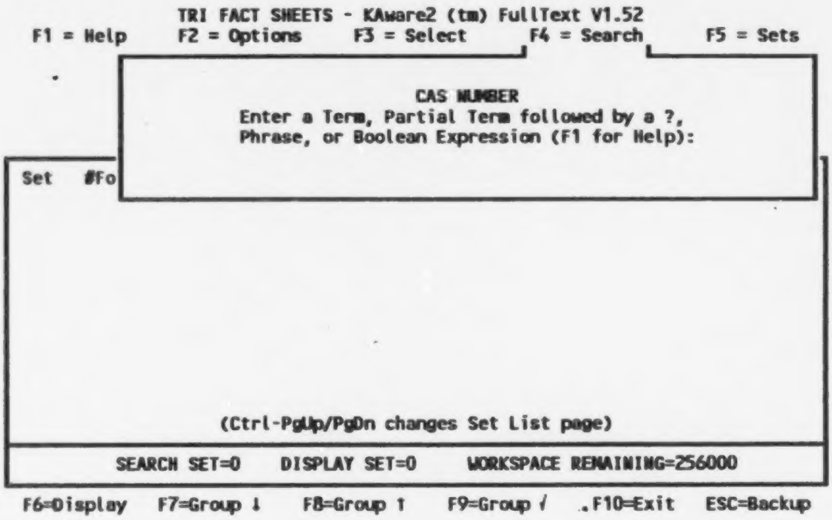
Type the common name and press **<ENTER>**. The TRI software will search for the common name and respond with the search results or a message will appear that says the common name you requested is unavailable. If you are unsure of the name or the spelling of the name, use the partial term option. When using the partial term option, type a term followed by a question mark (?) (e.g., ben?) and press **<ENTER>**. The message "Loading Words With BEN? Root" will appear. A listing of common names that start with the letters "BEN" will appear. Select the correct common name and press **<ENTER>**. It should be noted that each chemical is unique with distinct properties. Although two chemical names may start with "METHYL (methyl tert-butylether and methyl acrylate), it does not mean that these two chemicals have comparable or related characteristics and effects.



```
                    TRI FACT SHEETS - KAware2 (tm) FullText V1.52
  F1 = Help      F2 = Options      F3 = Select      F4 = Search      F5 = Sets
                                                   COMMON NAME
                                                 BENZAL [1]
                                                 BENZAMIDE [1]
                                                 BENZENAMINE [1]
                                                 BENZENE [3]
 Set   #Found       (Page 1 of 1)                BENZIDINE [1]
                                                 BENZOQUINONE [1]
  1     1/1     COMMON NAME:  BENZYL [1]         BENZOTRICHLORIDE [1]
                                                 BENZOYL [2]
                                                 BENZYL [1]

                      (Ctrl-PgUp/PgDn changes Set List page)
          SEARCH SET=1    DISPLAY SET=0     WORKSPACE REMAINING=255999
 F6=Display   F7=Group ↓    F8=Group ↑    F9=Group √    F10=Exit   ESC=Backup
```

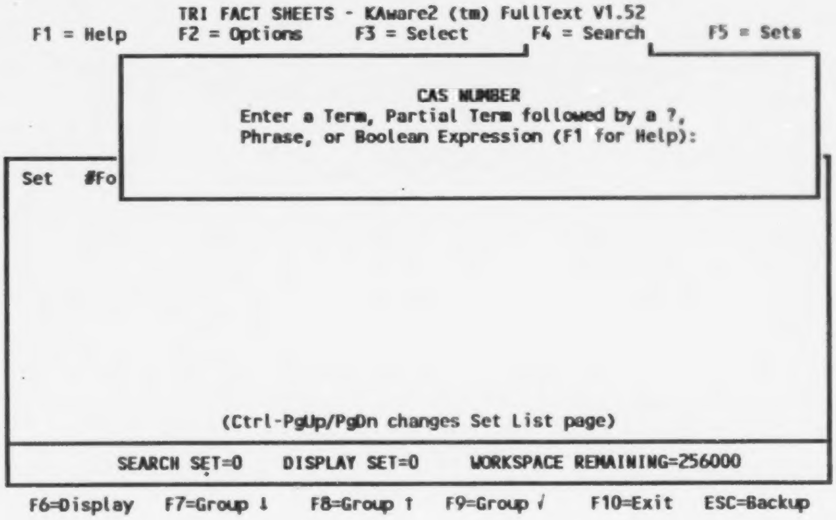
NOTE: Chemicals are often known by more than one name. In most instances, the same chemical name was used for TRI and the Fact Sheets. If you cannot find the "TRI Name", use the CAS Number that is found in the TRI record (see page 3-9).

CAS NUMBER - A Chemical Abstracts Service (CAS) number uniquely identifies an individual chemical. When known, searching by CAS number is the most precise way to search for chemical data. This choice allows you to type in a term, partial term (followed by a question mark (?)), phrase, or boolean expression to locate a CAS number. Dashes in a CAS number are required. Only the CAS number field will be searched. The format for a CAS number is as follows: first five positions can be digits (no leading zeros), followed by a dash (-), followed by two more digits (leading zero), followed by a dash (-), and then one more final digit (may be a zero).



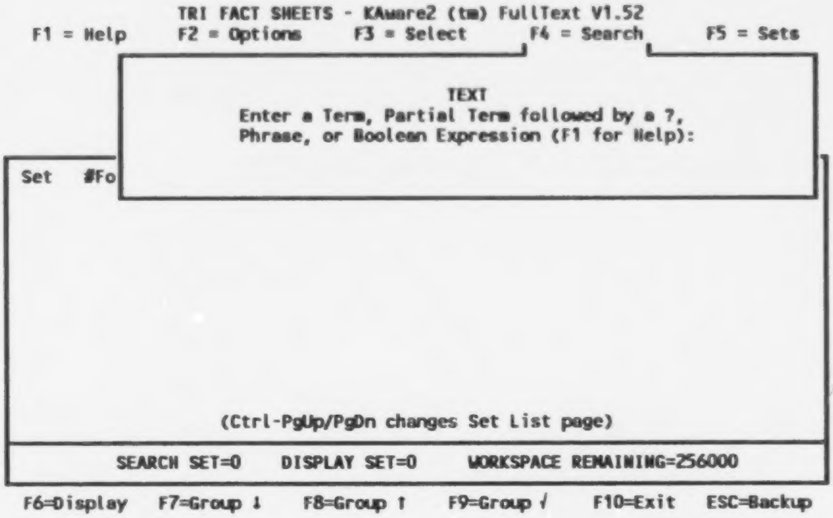
```
                 TRI FACT SHEETS - KAware2 (tm) FullText V1.52
 F1 = Help      F2 = Options     F3 = Select      F4 = Search      F5 = Sets

                                   CAS NUMBER
                    Enter a Term, Partial Term followed by a ?,
                    Phrase, or Boolean Expression (F1 for Help):

 Set   #Fo

                    (Ctrl-PgUp/PgDn changes Set List page)

       SEARCH SET=0     DISPLAY SET=0      WORKSPACE REMAINING=256000
 F6=Display   F7=Group ↓    F8=Group ↑    F9=Group √    F10=Exit   ESC=Backup
```

Type the complete CAS number and press **<ENTER>**. The TRI software will search for a CAS number and respond with the search results or a message will appear that says the CAS number you requested is unavailable. Check to ensure that the CAS number, including dashes, was entered correctly if the CAS number you requested is unavailable.



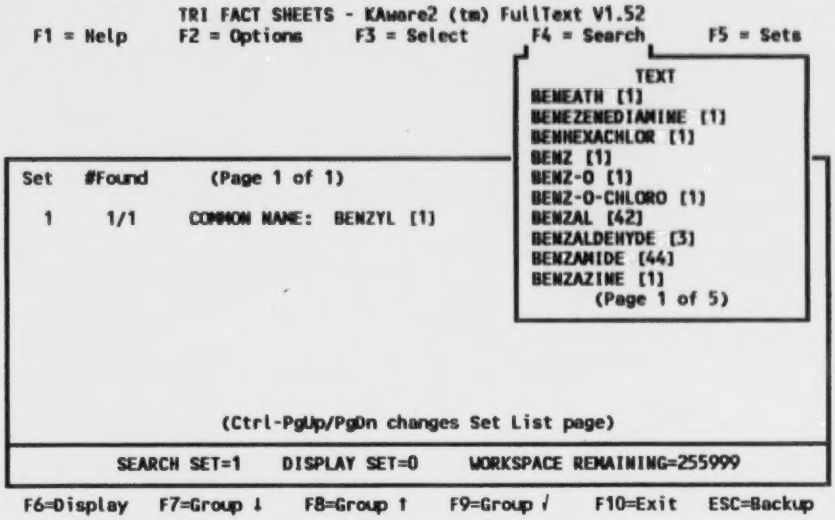
```
              TRI FACT SHEETS - KAware2 (tm) FullText V1.52
  F1 = Help     F2 = Options     F3 = Select     F4 = Search     F5 = Sets

                              CAS NUMBER
                 Enter a Term, Partial Term followed by a ?,
                 Phrase, or Boolean Expression (F1 for Help):

 Set    #Fo

                  (Ctrl-PgUp/PgDn changes Set List page)

       SEARCH SET=0     DISPLAY SET=0      WORKSPACE REMAINING=256000
 F6=Display   F7=Group ↓    F8=Group ↑   F9=Group √    F10=Exit   ESC=Backup
```

TEXT - This choice allows you to type in a term, partial term (followed by a question mark (?)), phrase, or boolean expression to locate text. Only the body of the Fact Sheet (or "text") is searched, not the chemical name or CAS number where they appear in the heading of the Fact Sheet. Proximity searching also is an effective way to search for specific text. This type of searching is useful when trying to locate text or words that are adjacent or near each other. Either of two formats may be used: 1) Using the search operator NEAR (e.g., EXPOSURE NEAR TOXICITY) will retrieve all documents where the two words occur in the same Fact Sheet or part of a Fact Sheet; 2) The search command WITHIN 1 will bring up all Fact Sheets where the first term is adjacent to the second search term (e.g., SKIN WITHIN 1 CONTACT will retrieve all Fact Sheets containing the term SKIN CONTACT).



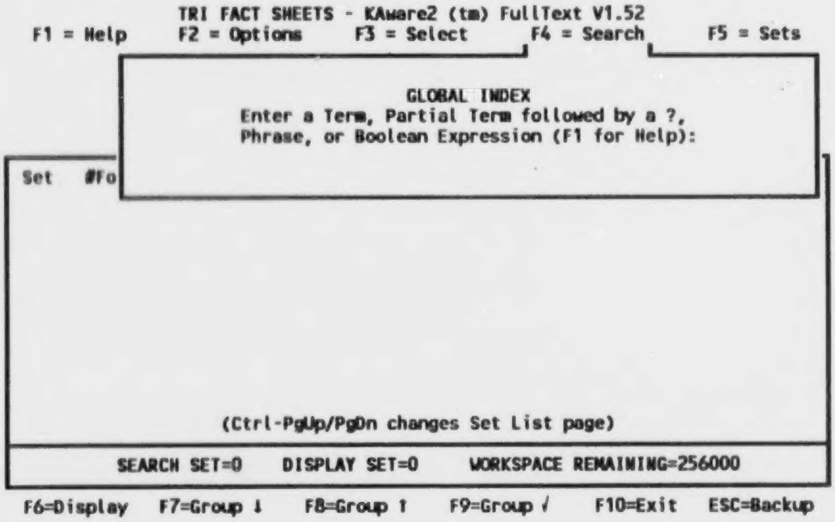
```
TEXT
Enter a Term, Partial Term followed by a ?,
Phrase, or Boolean Expression (F1 for Help):

(Ctrl-PgUp/PgDn changes Set List page)

SEARCH SET=0     DISPLAY SET=0     WORKSPACE REMAINING=256000
```

Type the text and press <ENTER>. The TRI software will search for the text and respond with a location of the text you have entered or a message will appear that says the text you requested is unavailable. You will then need to try again if the text was not found. When using the partial term option, type a term followed by a question mark (?) (e.g., ben?) and press <ENTER>. A listing of text that contains "BEN" will appear. Select the correct text and press <ENTER>.



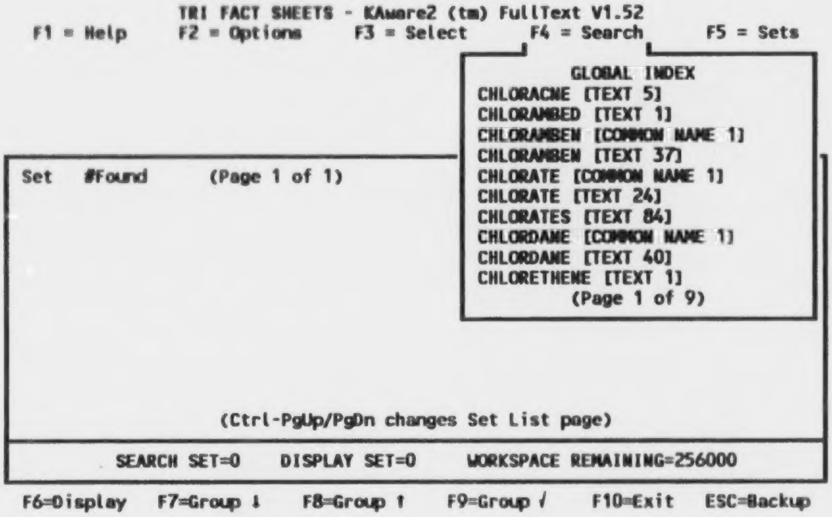
```
TRI FACT SHEETS - KAware2 (tm) FullText V1.52
F1 = Help     F2 = Options     F3 = Select     F4 = Search     F5 = Sets

                                             TEXT
                                    BENEATH [1]
                                    BENEZENEDIAMINE [1]
                                    BENHEXACHLOR [1]
                                    BENZ [1]
Set   #Found      (Page 1 of 1)     BENZ-O [1]
                                    BENZ-O-CHLORO [1]
 1     1/1     COMMON NAME:  BENZYL [1]   BENZAL [42]
                                    BENZALDEHYDE [3]
                                    BENZAMIDE [44]
                                    BENZAZINE [1]
                                         (Page 1 of 5)

              (Ctrl-PgUp/PgDn changes Set List page)
      SEARCH SET=1    DISPLAY SET=0     WORKSPACE REMAINING=255999
F6=Display   F7=Group ↓    F8=Group ↑    F9=Group √    F10=Exit   ESC=Backup
```

GLOBAL INDEX - This choice allows you to type in a term, partial term (followed by a question mark (?)), phrase, or boolean expression or proximity search to perform a global index search to locate data. The Global Index searches a combination of the CAS number, chemical common name, and text.



```
TRI FACT SHEETS - KAware2 (tm) FullText V1.52
F1 = Help     F2 = Options     F3 = Select     F4 = Search     F5 = Sets

                              GLOBAL INDEX
                Enter a Term, Partial Term followed by a ?,
                Phrase, or Boolean Expression (F1 for Help):
Set   #Fo

              (Ctrl-PgUp/PgDn changes Set List page)
      SEARCH SET=0    DISPLAY SET=0     WORKSPACE REMAINING=256000
F6=Display   F7=Group ↓    F8=Group ↑    F9=Group √    F10=Exit   ESC=Backup
```

Type the search term or expression and press <ENTER>. The TRI software will search the global index and respond with a location of the data that you have requested or a message will appear that says the search term or expression that you requested is unavailable. When using the partial term option, type a term followed by a question mark (?) (e.g.,CHL?) and press <ENTER>. The message, "Loading Words With CHL? Root" will appear. A listing of global index terms that start with CHL will appear, highlighting whether the index is a common name or text. Select the correct index entry and press <ENTER>.



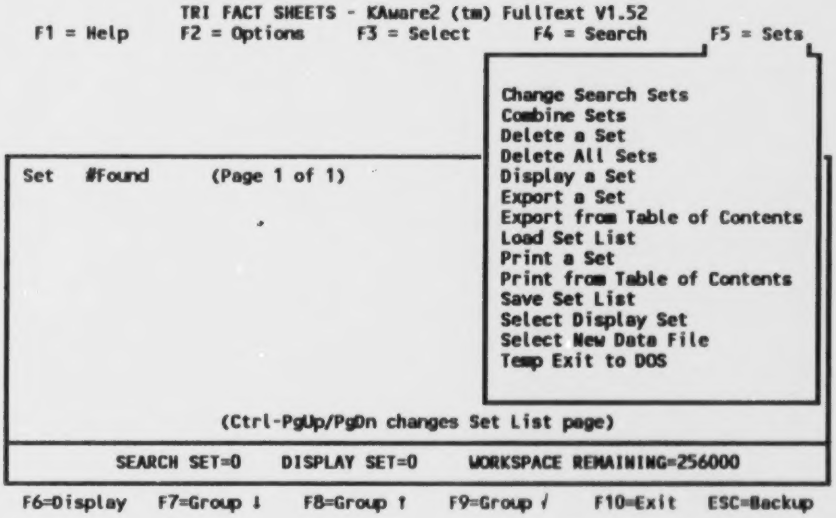
```
                 TRI FACT SHEETS - KAware2 (tm) FullText V1.52
 F1 = Help     F2 = Options     F3 = Select      F4 = Search      F5 = Sets
                                              GLOBAL INDEX
                                        CHLORACNE [TEXT 5]
                                        CHLORAMBED [TEXT 1]
                                        CHLORAMBEN [COMMON NAME 1]
                                        CHLORAMBEN [TEXT 37]
 Set   #Found       (Page 1 of 1)       CHLORATE [COMMON NAME 1]
                                        CHLORATE [TEXT 24]
                                        CHLORATES [TEXT 84]
                                        CHLORDANE [COMMON NAME 1]
                                        CHLORDANE [TEXT 40]
                                        CHLORETHENE [TEXT 1]
                                              (Page 1 of 9)

                   (Ctrl-PgUp/PgDn changes Set List page)

        SEARCH SET=0    DISPLAY SET=0     WORKSPACE REMAINING=256000
 F6=Display   F7=Group ↓    F8=Group ↑    F9=Group √    F10=Exit   ESC=Backup
```

3.2.4 F4 = SEARCH Key

F4 = Search - This option is directly related to the choices described for the F3 = Select option. See the NOTE for that option described above. Press <ESC> to leave this option.

3.2.5 F5 = SETS Key

F5 = Sets - This option provides selections to work with user defined sets of data in order to enhance the sets of data you create. The SETS pull-down menu is displayed below:



```
                    TRI FACT SHEETS - KAware2 (tm) FullText V1.52
     F1 = Help      F2 = Options     F3 = Select     F4 = Search      F5 = Sets

                                                  Change Search Sets
                                                  Combine Sets
                                                  Delete a Set
                                                  Delete All Sets
  Set   #Found       (Page 1 of 1)                Display a Set
                                                  Export a Set
                                                  Export from Table of Contents
                                                  Load Set List
                                                  Print a Set
                                                  Print from Table of Contents
                                                  Save Set List
                                                  Select Display Set
                                                  Select New Data File
                                                  Temp Exit to DOS

                           (Ctrl-PgUp/PgDn changes Set List page)

           SEARCH SET=0    DISPLAY SET=0      WORKSPACE REMAINING=256000
  F6=Display   F7=Group ↓    F8=Group ↑    F9=Group √     F10=Exit   ESC=Backup
```

There are various selections for this option which assist you in creating, printing, and displaying sets. Several examples are displayed below.

> Change Search Sets - This selection allows you to change to a specific set you have created and search for further information within that specific set. If you do not specify a set, the TRI software will search the entire file. (The current search set is shown at the bottom of the screen. SEARCH SET=0 means that the entire database is being searched.) Once the search set is changed, you must change the set back to zero (0) if you wish to resume searching the entire file. Using the Change Search Set option saves time and memory space, as the TRI software searches the entire database once, and then searches within the smaller set that was previously defined, to search for the second condition.

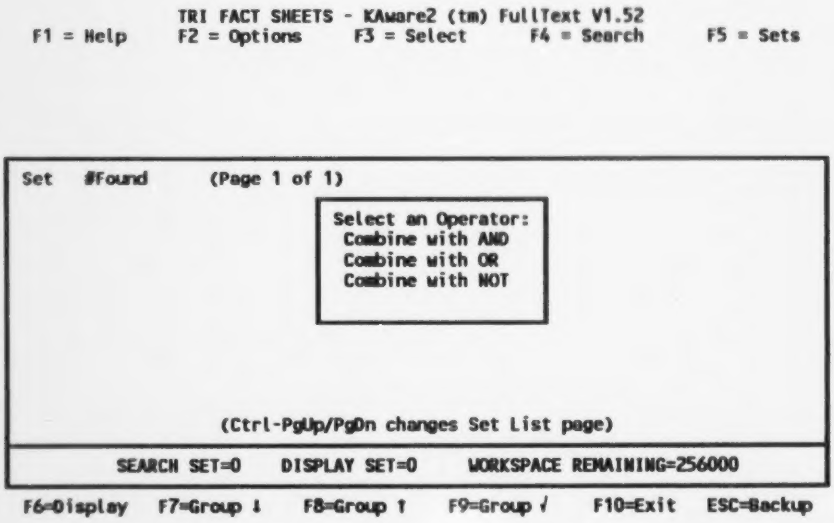
<u>Combine Sets</u> - This selection allows you combine user defined sets with additional conditions of AND, OR, or NOT. To understand the difference between these three conditions, let us use an example for each condition.

- Benzene AND Chlorine - The TRI software will search the database for <u>both</u> chemical names in the field being searched. AND limits the search to records meeting criteria for <u>all</u> of the sets that are being combined.

- Benzene OR Chlorine - The TRI software will search the database for <u>either</u> of the chemical names in the field being searched. OR broadens the search to include records that meet criteria for creating <u>any</u> of the searches being combined.

- Benzene NOT Chlorine - The TRI software will search the database for the first word <u>not</u> the second word in the field being searched. NOT includes records that meet criteria used to create the first set specified <u>except</u> records that were included in the second set that is combined.

  NOTE: When combining with NOT, you will obtain different results depending on which word you specify first.

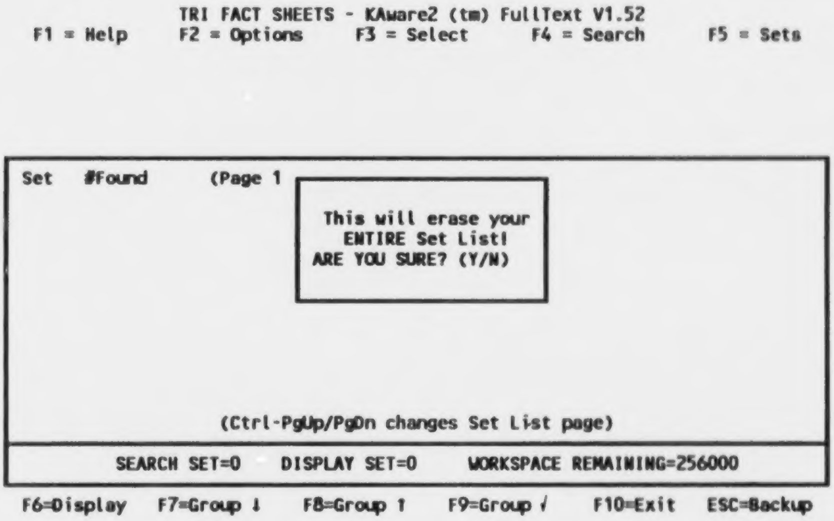


```
                 TRI FACT SHEETS - KAware2 (tm) FullText V1.52
F1 = Help       F2 = Options     F3 = Select      F4 = Search      F5 = Sets



 Set   #Found       (Page 1 of 1)
                                  Select an Operator:
                                   Combine with AND
                                   Combine with OR
                                   Combine with NOT



                     (Ctrl-PgUp/PgDn changes Set List page)

         SEARCH SET=0     DISPLAY SET=0     WORKSPACE REMAINING=256000
F6=Display   F7=Group ↓   F8=Group ↑   F9=Group √   F10=Exit   ESC=Backup
```

Select the condition and press **<ENTER>**. Set numbers are displayed on the screen under the SET category. In the set box, type the first set number, press **<ENTER>**, type the second set number, press **<ENTER>**, etc., until all the set numbers to be combined have been identified. You may give this newly created set a name. If you do not give the set a name, the TRI software will generate a name automatically.

Delete A Set - This selection allows you to delete a specific set. Deleting search sets that you do not need may be beneficial because it increases the the amount of workspace that is available for creating additional search sets. (See WORKSPACE REMAINING=????? in the lower right-hand side of the screen.) Once you have requested a deletion, that set will be highlighted on the screen with the word DELETED. Once deleted, it is no longer possible to retrieve that set, without searching the data again.

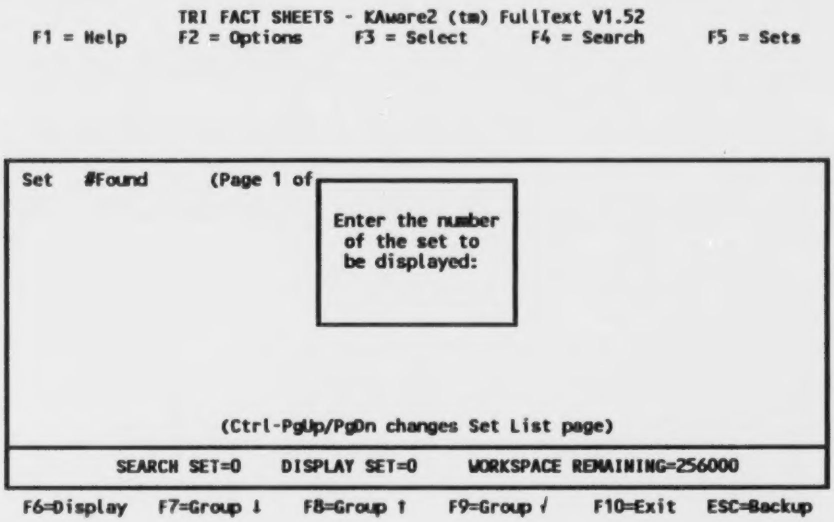
Delete All Sets - This selection allows you to delete all user defined sets. (To save records for a particular search to disk before deleting all sets, see Export A Set, below.)



```
                      TRI FACT SHEETS - KAware2 (tm) FullText V1.52
F1 = Help     F2 = Options     F3 = Select     F4 = Search     F5 = Sets


Set   #Found      (Page 1
                              This will erase your
                                ENTIRE Set List!
                              ARE YOU SURE? (Y/N)



                     (Ctrl-PgUp/PgDn changes Set List page)

         SEARCH SET=0    DISPLAY SET=0     WORKSPACE REMAINING=256000
F6=Display   F7=Group ↓    F8=Group ↑    F9=Group √    F10=Exit   ESC=Backup
```

If you answer YES by typing **<Y>** to the erasure of all sets, you will no longer be able to access them. All sets will have to be recreated. If you answer NO by typing **<N>**, no sets will be erased.

Display A Set - This selection allows you display any user defined set.



```
                TRI FACT SHEETS - KAware2 (tm) FullText V1.52
F1 = Help       F2 = Options     F3 = Select      F4 = Search      F5 = Sets

Set    #Found       (Page 1 of
                              Enter the number
                               of the set to
                               be displayed:

                   (Ctrl-PgUp/PgDn changes Set List page)

          SEARCH SET=0     DISPLAY SET=0      WORKSPACE REMAINING=256000

F6=Display   F7=Group ↓    F8=Group ↑     F9=Group √     F10=Exit   ESC=Backup
```

Type the number of the set to be displayed and press **<ENTER>**. If the set number you have entered does not correspond with a set number displayed, the field in the box erases the value you have entered and displays a blank. Enter the correct set number.

Export A Set - This selection allows you to save search results in ASCII format to be used with other software. Enter the number of the set to be saved for exporting, name of the file to be saved, and press **<ENTER>**. A message will appear telling you the set has been saved.

Export from Table of Contents - This selection allows you to save a record using the common name from the Table of Contents. Name the file to be saved on the C drive. A message will appear telling you the set has been saved.

Load Set List - This selection allows you to load a set list that you have previously saved. When you load a set list, all currently displayed set lists that have not been previously saved, will be erased. Select a set list from the box displaying all the saved set lists.

Print A Set - This selection allows you to print a set to a local printer. Enter the set number to be printed. If the set number you have entered does not correspond with a set number that exists, the field in the box erases the value you have entered and displays a blank. Enter the correct set number. The set will be printed on a local printer.

Print from Table of Contents - This selection allows you to select a chemical name from the Table of Contents name and send the record for that chemical to a local printer to be printed.

Save Set List - This selection allows you to save a set list to the C drive so that you can retrieve it at a later date. The system will supply the suffix, .SSL.

NOTE: Caution! If you save set lists to a drive other than C, the file must be copied to the current directory where the CD-ROM is loaded (e.g., C:\REL\) to be loaded. This process saves only the list - not the actual records retrieved. To save search results, use Export A Set.

Select Display Set - This selection allows you to display a set using the F6 key (F6=Display). See the F6=Display section below for more information.

Select New Data File - It is not recommended that you exercise this option. This software feature was designed for products that contain multiple text files on one disc. The TRI disc, however, contains only one text file - the Fact Sheets. If you press **Select New Data File** accidentally, press **<ESC>** to return to the **TRI Fact Sheets Main Menu**. You may have to repeat searches that were conducted earlier.

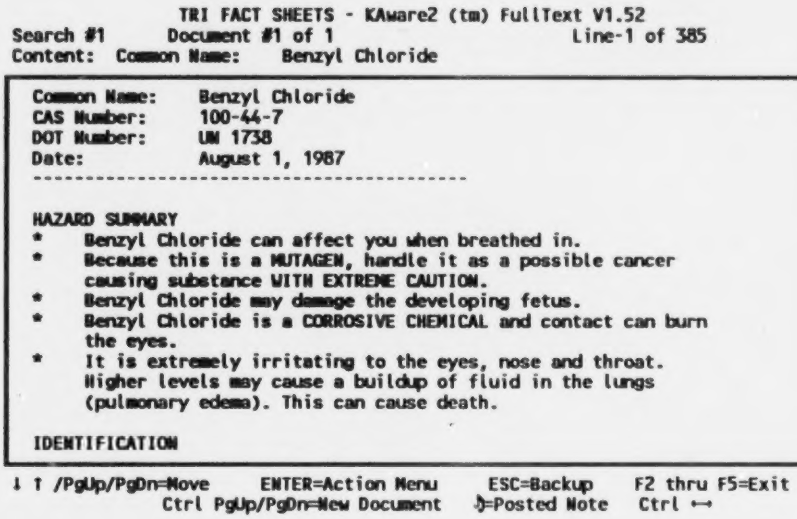
Temp Exit to DOS - This selection allows you to temporarily exit to DOS. Once you are at the DOS prompt, you can return to the **TRI Fact Sheets Main Menu** by typing **<EXIT>** and pressing **<ENTER>**.

3.2.6 F6=DISPLAY Key

F6=Display - This option displays Fact Sheets for the chemicals in the data set you have created (or the display set shown at the bottom of the screen). Working with the common name, Benzyl, that was used for the select process as an example, the Fact Sheet for BENZYL would be displayed. The illustration below shows the Fact Sheet for Benzyl, the chemical used as an example for the select process. Press **<CTRL>** and **<PGDN>** simultaneously to skip to the next record when displaying search results containing multiple records.

When you display data, you will notice a status line at the bottom of the screen, which highlights the Search Set, Display Set, and Workspace Remaining.

- Search Set - identifies which set is being searched; a Search Set = 0 means the entire database will be searched.
- Display Set - identifies which set will be displayed when you press F6.
- Workspace Remaining - identifies the amount of free storage space remaining.



```
                  TRI FACT SHEETS - KAware2 (tm) FullText V1.52
Search #1       Document #1 of 1                           Line-1 of 385
Content:  Common Name:    Benzyl Chloride

  Common Name:     Benzyl Chloride
  CAS Number:      100-44-7
  DOT Number:      UN 1738
  Date:            August 1, 1987
  ------------------------------------------

  HAZARD SUMMARY
  *     Benzyl Chloride can affect you when breathed in.
  *     Because this is a MUTAGEN, handle it as a possible cancer
        causing substance WITH EXTREME CAUTION.
  *     Benzyl Chloride may damage the developing fetus.
  *     Benzyl Chloride is a CORROSIVE CHEMICAL and contact can burn
        the eyes.
  *     It is extremely irritating to the eyes, nose and throat.
        Higher levels may cause a buildup of fluid in the lungs
        (pulmonary edema). This can cause death.

  IDENTIFICATION

↓ ↑ /PgUp/PgDn=Move     ENTER=Action Menu     ESC=Backup    F2 thru F5=Exit
                Ctrl PgUp/PgDn=New Document   ♪=Posted Note   Ctrl ↔
```

This function key will display one of the following choices, depending on your selection from the Display Set option (F2 = Options): Search Set, Last Set Created, or Selected Set. Display Set = ???, at the bottom of the screen, identifies the set that is displayed when you press F6.

3.2.7 F7=GROUP ↓, F8=GROUP ↑, F9=GROUP ✓ Keys

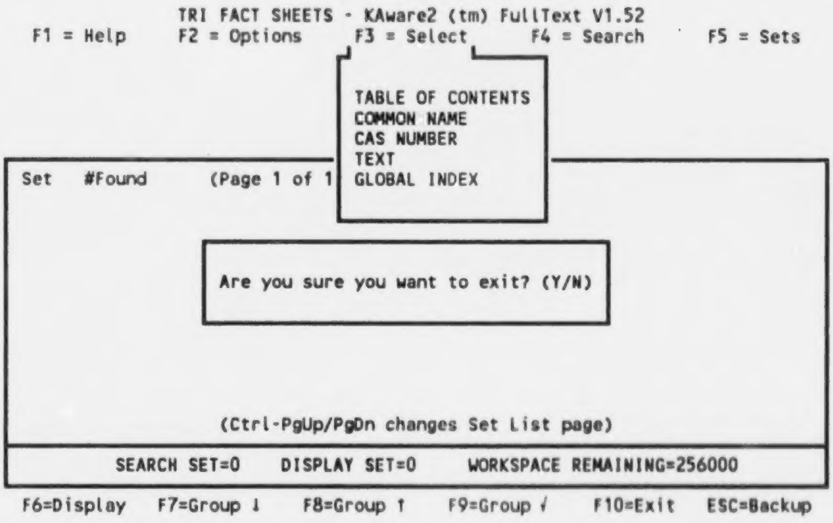
F7=Group ↓, F8=Group ↑, F9=Group ✓ - These options are used to search for specific data when terms are listed through the F4 = Search option. Use these keys to group terms together or to identify a specific term to retrieve.

To mark the beginning of a range of terms, move the highlight bar with the up and down arrows to the first term to start the range and press **<F7>**. A down arrow will appear next to that item. Move the highlight bar to the last item in the range and press **<F8>**. An up arrow will appear next to that item. If you need to select items individually that are not related, highlight each individual desired item using the up and down arrows and press **<F9>**. A check mark will appear next to each item selected.

After defining the group search using the F7, F8, and F9 keys, press **<ENTER>** to begin the search. Each item contained in defined ranges (F7 and F8) or marked individually (F9) will be searched one at a time, and the results combined to form a search set.

3.2.8 F10=EXIT Key

F10=Exit - This option will exit you from the Fact Sheet option and return you to the **Data Base Selection Menu**.



```
                 TRI FACT SHEETS - KAware2 (tm) FullText V1.52
F1 = Help        F2 = Options    F3 = Select      F4 = Search      F5 = Sets

                                 TABLE OF CONTENTS
                                 COMMON NAME
                                 CAS NUMBER
                                 TEXT
Set   #Found     (Page 1 of 1    GLOBAL INDEX

                 Are you sure you want to exit? (Y/N)

                 (Ctrl-PgUp/PgDn changes Set List page)
      SEARCH SET=0    DISPLAY SET=0     WORKSPACE REMAINING=256000
F6=Display   F7=Group ↓   F8=Group ↑   F9=Group √   F10=Exit   ESC=Backup
```

Press **<Y>** to return to the **Data Base Selection Menu**. Press **<N>** to return the **TRI Fact Sheets Main Menu**.

3.2.9 ESC=BACKUP Key

<u>ESC=Backup</u> - This option will return you to the previous screen.

3.3 Conducting A Search For Fact Sheets

To assist you in searching for a specific Fact Sheet using the TRI CD-ROM Software, this section will describe how to conduct a search, using a simple example. You can refer to Sections 3.0 and 3.2, to review specific screens.

1. Press **<F3>** and decide which part of the file is most efficient to search. Highlight the choice and press **<ENTER>**.

2. Construct the search based on fields to be searched and press **<ENTER>**.

For this example, you need to locate a Fact Sheet about the chemical, Methylene, as you are concerned about health affects related to this chemical.

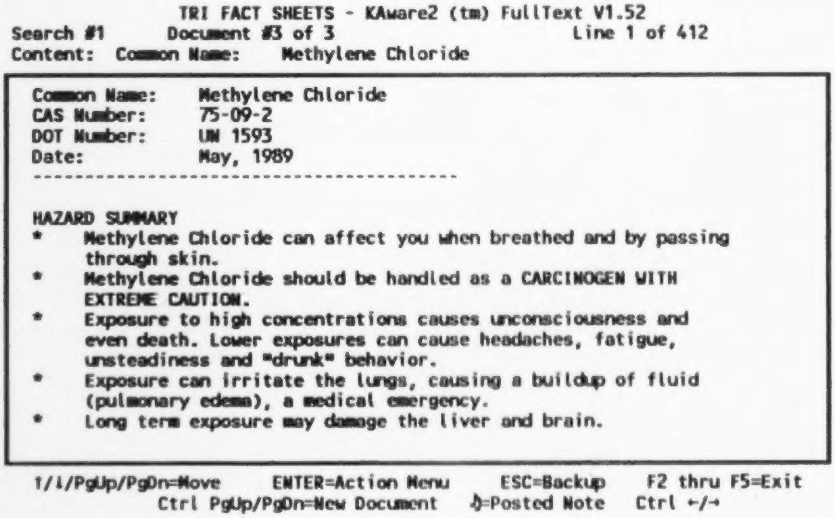
Once you have selected **TRI Fact Sheets** from the **DATA BASE SELECTION MENU**, you can begin your search for a specific Fact Sheet. First, you will need to determine what selection criteria you will use. For this example, we will use common name. Choose "Common Name" from the F3 = Select option and press **<ENTER>**. The Common Name Box is displayed. Suppose you are not sure how to spell the chemical, Methylene. Type **METH?** and press **<ENTER>**. A box appears showing you all the chemical names that start with the letters METH. Use the down arrow to highlight the correct chemical name, Methylene, and press **<ENTER>**. Five Fact Sheets about methylene or related chemicals can be displayed. Remember, because two chemicals have methylene in their names does not necessarily mean the two chemicals are comparable for health effects.

Now that you have created a set for the chemical, methylene, suppose you also would like to review material about methylene and health issues, specifically cancer concerns. You will need to create a set, retrieving data on cancer issues. Then, combine the two sets together to create a set that contains Fact Sheets on methylene and cancer issues. Let's explain how to create these sets. Select the "text" choice from the F3 = Select option pull-down menu. Type "cancer" and press **<ENTER>**. The TRI software will display that there are 323 Fact Sheets containing 996 occurrences of "cancer". You have now created two sets, which are displayed on the screen. Next, you will need to combine these two sets. Select the F5 = Sets option pull-down menu. Choose the Combine Sets selection and highlight the Combine With AND option and press **<ENTER>** and press **<ENTER>** again. Follow the instructions to combine sets 1 (methylene) and 2 (cancer). Give the combined set a name. This combined set becomes the third set on the screen.

3.4 Displaying Fact Sheets

To display the Fact Sheets about Methylene, select the F5 = Sets option and the pull-down menu appears. Highlight the Display A Set selection and press **<ENTER>**. Enter #1 to display the Fact Sheets for methylene. To display the combined set, showing methylene and cancer issues, follow the same instructions but enter #3 as the set to display. As you move through the text, the word, "Cancer", will be highlighted, to bring it to your attention. Use the options displayed at the bottom of the screen to browse through the information.

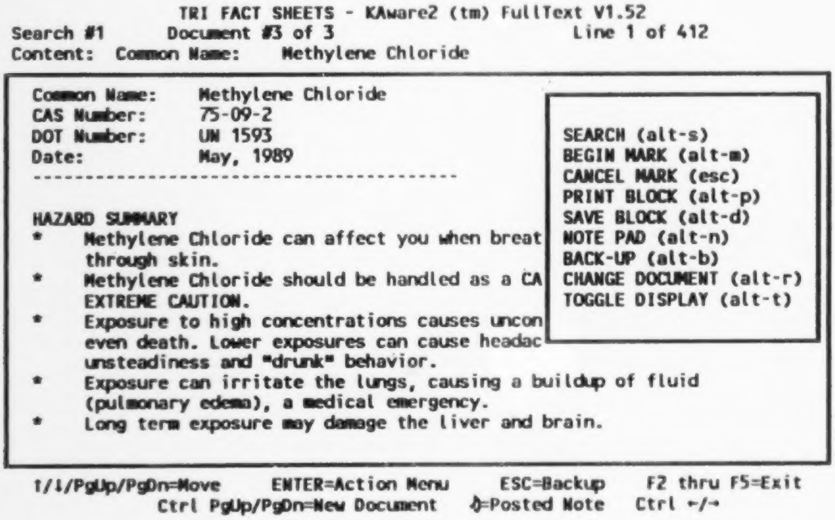
When you display a Fact Sheet, there are several additional options that exist to enhance the Fact Sheet. These options are displayed in the Action Menu and are accessed by pressing **<ENTER>** while you are reviewing the Fact Sheet.



```
                    TRI FACT SHEETS - KAware2 (tm) FullText V1.52
Search #1      Document #3 of 3                          Line 1 of 412
Content:  Common Name:    Methylene Chloride

  Common Name:    Methylene Chloride
  CAS Number:     75-09-2
  DOT Number:     UN 1593
  Date:           May, 1989
  ----------------------------------------

  HAZARD SUMMARY
  *     Methylene Chloride can affect you when breathed and by passing
        through skin.
  *     Methylene Chloride should be handled as a CARCINOGEN WITH
        EXTREME CAUTION.
  *     Exposure to high concentrations causes unconsciousness and
        even death. Lower exposures can cause headaches, fatigue,
        unsteadiness and "drunk" behavior.
  *     Exposure can irritate the lungs, causing a buildup of fluid
        (pulmonary edema), a medical emergency.
  *     Long term exposure may damage the liver and brain.

  ↑/↓/PgUp/PgDn=Move      ENTER=Action Menu     ESC=Backup     F2 thru F5=Exit
              Ctrl PgUp/PgDn=New Document    ♪=Posted Note    Ctrl ←/→
```

3.5 Action Menu

When you display a set, there are several options available to enhance the display of the data. These options are available in the Action Menu and are accessed by pressing **<ENTER>** while you are viewing the information.



```
                    TRI FACT SHEETS - KAware2 (tm) FullText V1.52
Search #1      Document #3 of 3                          Line 1 of 412
Content:  Common Name:    Methylene Chloride

  Common Name:    Methylene Chloride
  CAS Number:     75-09-2                       SEARCH (alt-s)
  DOT Number:     UN 1593                       BEGIN MARK (alt-m)
  Date:           May, 1989                     CANCEL MARK (esc)
  ----------------------------------------      PRINT BLOCK (alt-p)
                                                SAVE BLOCK (alt-d)
  HAZARD SUMMARY                                NOTE PAD (alt-n)
  *     Methylene Chloride can affect you when breat BACK-UP (alt-b)
        through skin.                           CHANGE DOCUMENT (alt-r)
  *     Methylene Chloride should be handled as a CA TOGGLE DISPLAY (alt-t)
        EXTREME CAUTION.
  *     Exposure to high concentrations causes uncon
        even death. Lower exposures can cause headac
        unsteadiness and "drunk" behavior.
  *     Exposure can irritate the lungs, causing a buildup of fluid
        (pulmonary edema), a medical emergency.
  *     Long term exposure may damage the liver and brain.

  ↑/↓/PgUp/PgDn=Move      ENTER=Action Menu     ESC=Backup     F2 thru F5=Exit
              Ctrl PgUp/PgDn=New Document    ♪=Posted Note    Ctrl ←/→
```

To perform any of the selections in the **Action Menu**, use the up and down arrows to choose one of the selections. Once the highlighted bar is on the correct choice, press **<ENTER>**. You also can activate any of the selections in the **Action Menu** by pressing the keys displayed next to the choice. These keys are known as "Hot Keys". For example, to search, press the **<Alt>** and the **<s>** keys simultaneously to activate the search capability. For example, you may wish to search other Fact Sheets for a word that appears in the Fact Sheet you are viewing. Highlight the word you wish to search and press the **<ALT>** and the **<s>** keys simultaneously. A new search set containing Fact Sheets in which the highlighted word also appears will be created and displayed automatically. You can use these "Hot Keys" to activate a selection directly from the Fact Sheet without requesting the **Action Menu**. If you are in the **Action Menu** and do not wish to activate any of the selections, press **<ESC>** to leave the **Action Menu**.

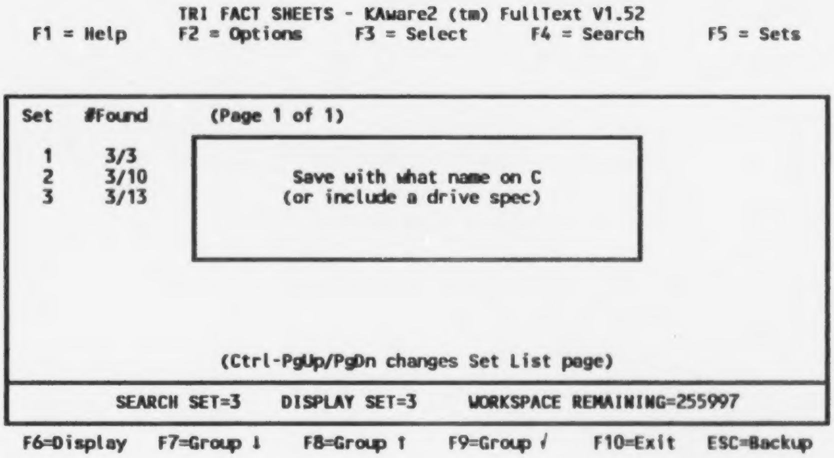
3.6 Printing or Saving Fact Sheets

Once you have viewed the Fact Sheet information, you may want to keep it. You can use the print option to retain information. Access the F5 = Sets pull-down menu. Select the Print A Set choice. Enter the set number you would like to print to your local printer and press **<ENTER>**. The TRI software will display the message, "Now sending Set # to printer. ESCAPE cancels printing". If you press **<ESC>**, the screen will display the message, "Printed Set is Interrupted. Press any key to continue". You will leave the print option. If you do not press **<ESC>**, Fact Sheet information will be printed on your printer.

NOTE: Caution! Each Fact Sheet may be several pages in length.

3.7 Save Set List

There will be certain situations where you will create fact sheet sets that you would like to save in order to retrieve these sets at a later date. Set lists contain all the user defined sets. If you do not request a set to be saved, it will be erased when you exit from the TRI software and will have to be recreated. Saving a set avoids this problem. To save a set, access the F5 = Sets pull-down menu. Highlight the Save Set List option and press **<ENTER>**. The Save Set List Screen is displayed below:



```
                  TRI FACT SHEETS - KAware2 (tm) FullText V1.52
     F1 = Help     F2 = Options     F3 = Select     F4 = Search     F5 = Sets

   Set   #Found        (Page 1 of 1)

    1     3/3
    2     3/10               Save with what name on C
    3     3/13             (or include a drive spec)



                   (Ctrl-PgUp/PgDn changes Set List page)

          SEARCH SET=3    DISPLAY SET=3     WORKSPACE REMAINING=255997
   F6=Display   F7=Group ↓    F8=Group ↑    F9=Group √    F10=Exit   ESC=Backup
```

Make sure you save the correct set list. The name will appear on the screen. If this name or drive is incorrect, modify it and press **<ENTER>** to save the set. The suffix, .SSL, is provided to the set list file.

NOTE: It is recommended that set lists be saved to the C drive for easy retrieval. If you save your set lists to a drive other than the C drive, copy your set lists to the TRI directory on the C drive (c:\TRI).

3.8 Load Set List

Use the Load Set List option to retrieve a Fact Sheet set list that you have saved, as described in Section 3.7, Save Set List. Access the F5 = Sets pull-down menu. Highlight the Load Set List option and press **<ENTER>**. Enter the set number you want to retrieve and press **<ENTER>**. The set will appear on the screen and is available for access.

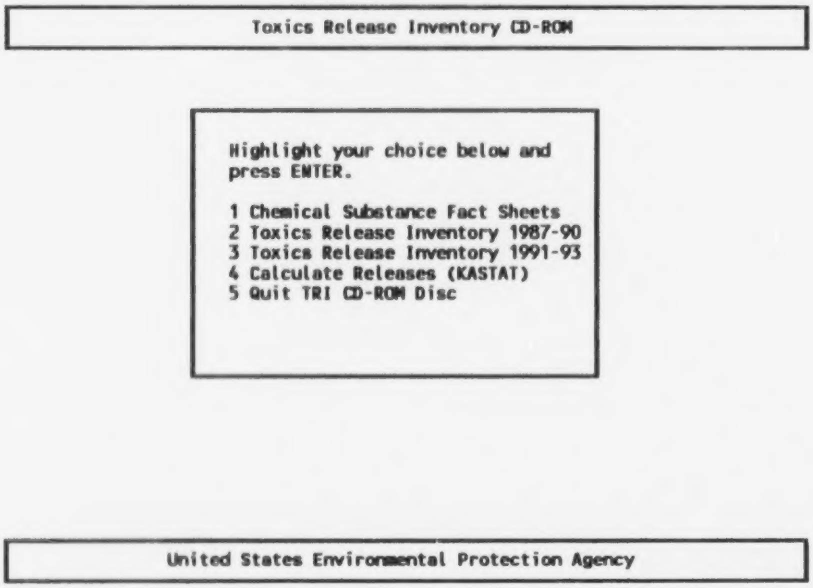
4.0 Toxics Release Inventory Data Base

This chapter describes in detail the steps used to search for data and display and print the results from these searches. It also illustrates techniques for designing your own reports, downloading data, and performing calculations on data sets that are of interest to you.

4.1 Choosing a Data File

The Toxics Release Inventory data base is produced on two CD-ROM discs. Disc One contains TRI submissions for 1987-1990, while Disc Two contains records from 1991-1993. Each of the discs can be used independently, or you can search the discs consecutively to identify longitudinal trends that have occurred since the inception of TRI. In addition to the data files, the CD-ROMs contain retrieval software that provides the capability to search for specific data on toxic chemicals released into the environment by manufacturing facilities. This software was transferred to your hard disk during the installation process.

To begin using TRI, insert either Disc One or Disc Two into the CD-ROM drive. Change to the subdirectory where software for accessing that disc was installed. (The default directory, unless another directory name was chosen during the installation process, is called TRI.) Type **TRI <ENTER>** to retrieve the **DATA BASE SELECTION MENU**, shown below:

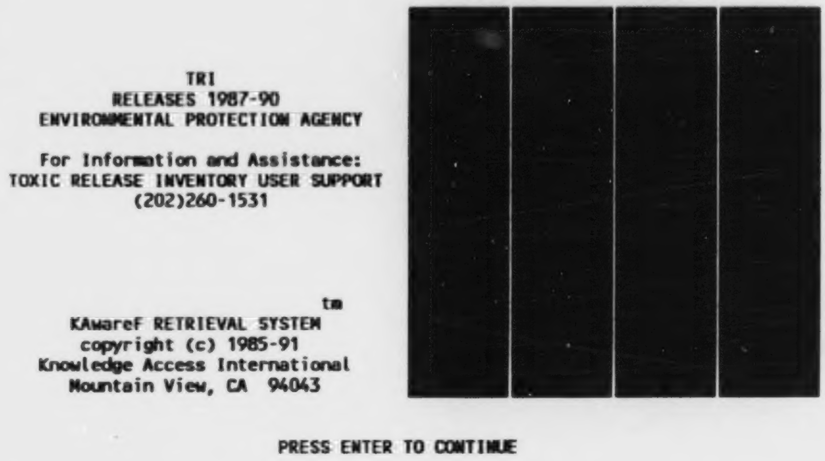


```
Toxics Release Inventory CD-ROM

Highlight your choice below and
press ENTER.

1 Chemical Substance Fact Sheets
2 Toxics Release Inventory 1987-90
3 Toxics Release Inventory 1991-93
4 Calculate Releases (KASTAT)
5 Quit TRI CD-ROM Disc

United States Environmental Protection Agency
```

Using the cursor key, highlight **2 Toxics Release Inventory 1987-1990** or **3 Toxics Release Inventory 1991-1993** and press **<ENTER>**. (Most of the examples shown throughout this manual are based on the 1991-1993 TRI contained on Disc Two.)

If the disc present in the CD-ROM drive does not match your selection, a message instructing you to change discs and press **<ENTER>** will appear on the screen.

Depending on your selection, one of two screens will be displayed:



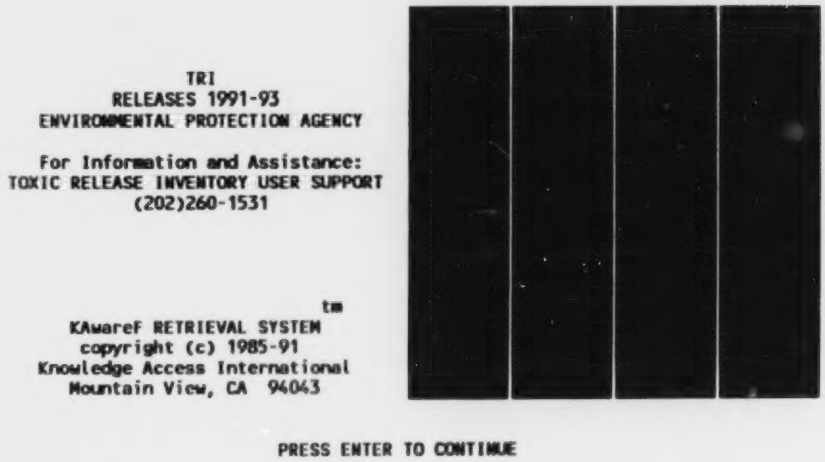
TRI
RELEASES 1987-90
ENVIRONMENTAL PROTECTION AGENCY

For Information and Assistance:
TOXIC RELEASE INVENTORY USER SUPPORT
(202)260-1531

tm
KAwareF RETRIEVAL SYSTEM
copyright (c) 1985-91
Knowledge Access International
Mountain View, CA 94043

PRESS ENTER TO CONTINUE

OR:



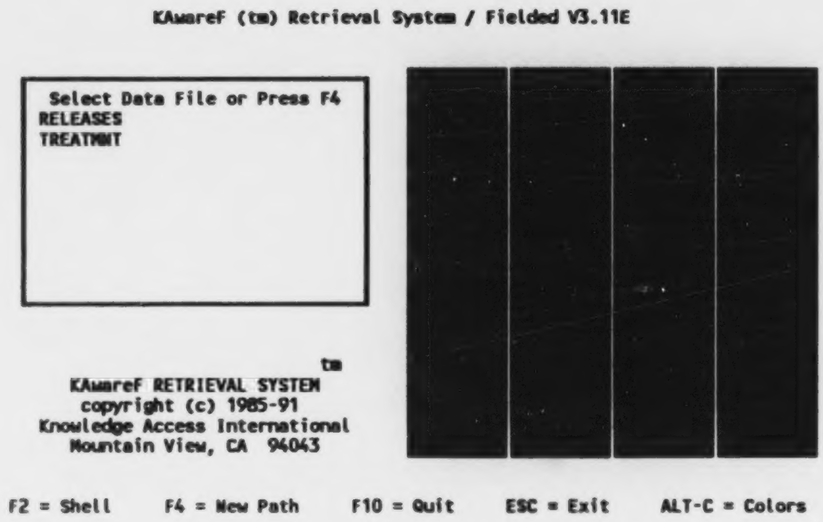
TRI
RELEASES 1991-93
ENVIRONMENTAL PROTECTION AGENCY

For Information and Assistance:
TOXIC RELEASE INVENTORY USER SUPPORT
(202)260-1531

tm
KAwareF RETRIEVAL SYSTEM
copyright (c) 1985-91
Knowledge Access International
Mountain View, CA 94043

PRESS ENTER TO CONTINUE

Press **<ENTER>** and the **DATA FILES SCREEN** will be displayed:



```
KAwareF (tm) Retrieval System / Fielded V3.11E

Select Data File or Press F4
RELEASES
TREATMNT

                          tm
KAwareF RETRIEVAL SYSTEM
copyright (c) 1985-91
Knowledge Access International
Mountain View, CA  94043

F2 = Shell    F4 = New Path    F10 = Quit    ESC = Exit    ALT-C = Colors
```

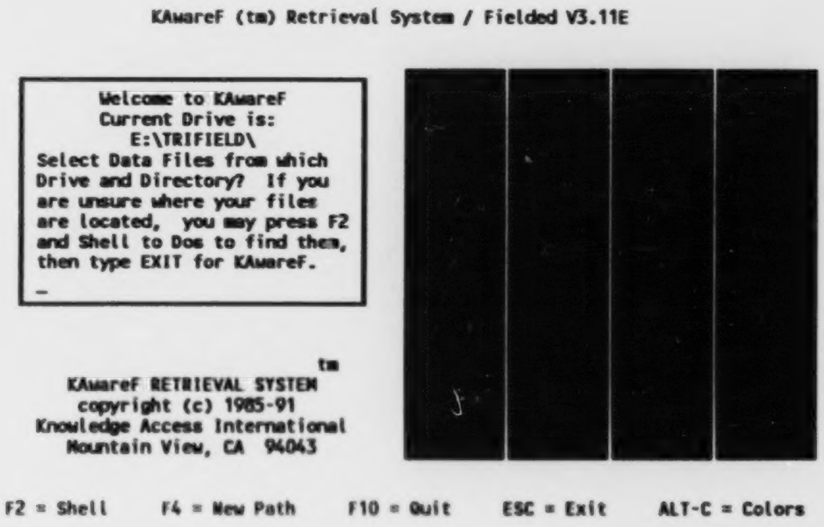
The **DATA FILES SCREEN** lists the names of the two files, RELEASES and TREATMNT, that comprise the TRI:

> The RELEASES file is the most frequently-used file. This file provides comprehensive facility identification and chemical information. Use this file when searching for specific data on releases to the air, water, land, underground injection wells, publicly owned treatment works (POTWs, commonly called sewer plants) and offsite locations. The Releases file also describes pollution prevention methods, including waste reduction and recycling activities, employed by the facility. Examples of use could include searching for chemicals that were released in your town/community or into specific bodies of water like the Chesapeake Bay or Lake Erie. Searching RELEASES would also reveal transfers of chemical wastes to local POTWs or offsite commercial facilities by name (for example, transfers to ABC Waste Management Company) or by location (such as off-site locations in Houston, Texas).
>
> The TREATMNT file is used to search for data on waste treatment methods and efficiency, and waste minimization. It is generally more effective to conduct a search of the RELEASES file, then replicate the search in TREATMNT if waste treatment information is also desired.

To select a data file, use the cursor to highlight either RELEASES or TREATMNT and press **<ENTER>**. (Because it is the most commonly used file, many of the examples shown in this chapter are based on searching fields from the RELEASES file. Because the same software is used to retrieve data from both files, the same techniques can be used for searching the TREATMNT file, as well.)

The **DATA FILES SCREEN** displays several options, described below, at the bottom of the screen:

> F2 = Shell - This option allows you to return to DOS. You would use this option to locate the drive and the directory where your data files are located. Once you are at the TRI directory prompt, you will see the message, "Type EXIT to return to KAwareF." Type **<EXIT>** and press **<ENTER>** to return to the TRI software.
>
> F4 = New Path - This option allows you to change to the path and directory where data files are located. When this option is selected, the TRI Current Drive box, is displayed:

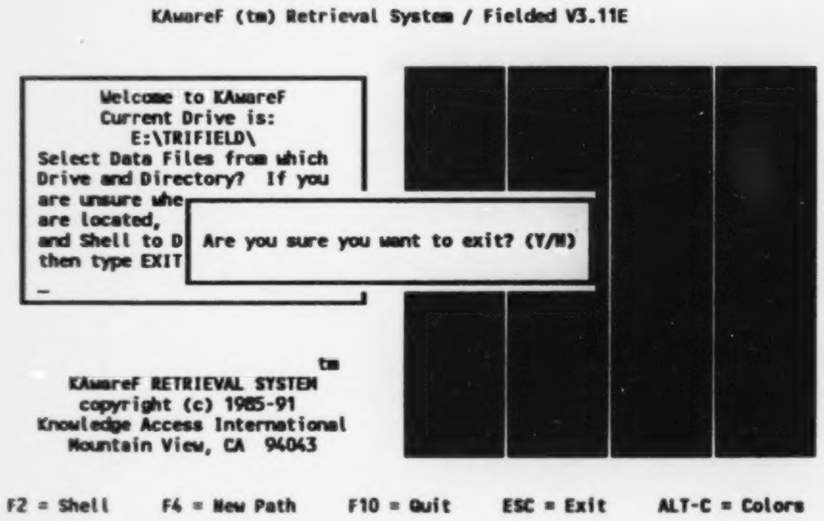


```
               KAwareF (tm) Retrieval System / Fielded V3.11E

       Welcome to KAwareF
       Current Drive is:
          E:\TRIFIELD\
   Select Data Files from which
   Drive and Directory?  If you
   are unsure where your files
   are located,  you may press F2
   and Shell to Dos to find them,
   then type EXIT for KAwareF.

   _

                               tm
     KAwareF RETRIEVAL SYSTEM
       copyright (c) 1985-91
   Knowledge Access International
     Mountain View, CA  94043

F2 = Shell     F4 = New Path     F10 = Quit     ESC = Exit     ALT-C = Colors
```

The path for the TRI files on the CD-ROM is displayed, and the option to change the drive and directory by typing in new information is provided. If your system is properly configured to use the TRI data base, the path shown should contain the correct letter assigned to the drive where the TRI CD-ROM is located and the directory name TRIFIELD (e.g., E:\TRIFIELD\). If necessary, type the specified directory and file name and press **<ENTER>**.

If an incorrect path is entered, the message "Are you sure you want to exit ? (Y/N)" is displayed. If that happens, press **N <ENTER>** and reenter the correct path, substituting the correct letter for the CD-ROM drive based on your configuration.

F10 = Quit - For this option, a box is displayed:



```
           KAwareF (tm) Retrieval System / Fielded V3.11E

      Welcome to KAwareF
      Current Drive is:
        E:\TRIFIELD\
 Select Data Files from which
 Drive and Directory?  If you
 are unsure whe
 are located,
 and Shell to D  Are you sure you want to exit? (Y/N)
 then type EXIT
 _

                            tm
     KAwareF RETRIEVAL SYSTEM
      copyright (c) 1985-91
  Knowledge Access International
     Mountain View, CA  94043

 F2 = Shell    F4 = New Path    F10 = Quit    ESC = Exit    ALT-C = Colors
```

Press **<Y>** to return to the **DATA BASE SELECTION MENU**. A similar screen containing the telephone number for TRI User Support will appear. Press **<ENTER>** to continue. Otherwise, press **<N>** to return to the **DATA FILES SCREEN**.

ESC = Exit - For this option, the ESC key performs the same function as the F10 key and will display the Exit TRI Data Base Screen (as described above). Proceed in the same manner as described for the F10 = Quit option.

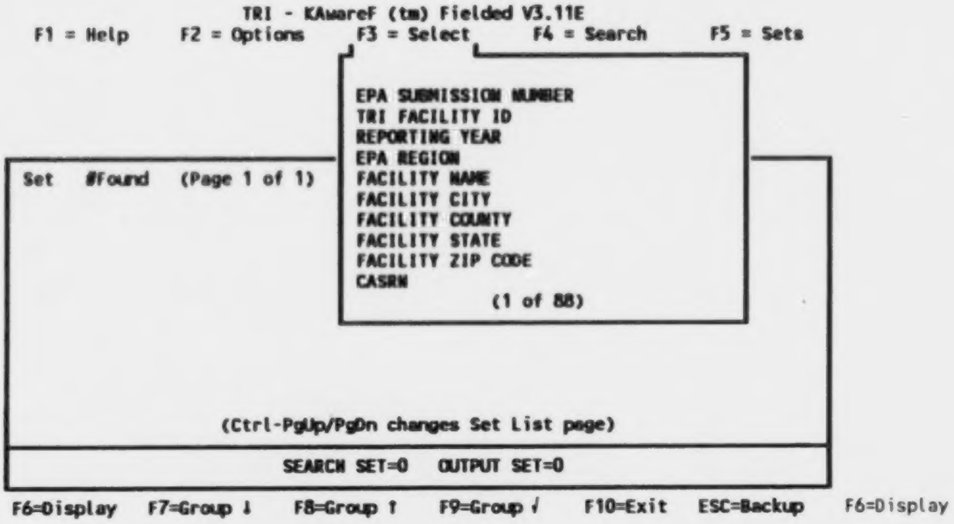
ALT-C = Colors - When you press the Alt and C keys simultaneously, the screen will change from color to black and white. Press the keys again simultaneously to return the screen to color.

4.2 Overview of Conducting A Search

To conduct a search of TRI data, there are several simple steps. You will need to SELECT the data elements for the specific information you need, SEARCH for specific values related to those data elements, DISPLAY the data, and PRINT the data for later viewing or EXPORT (download) the data to other software formats. Use of the function keys for performing each of these operations is described in subsequent sections of this chapter.

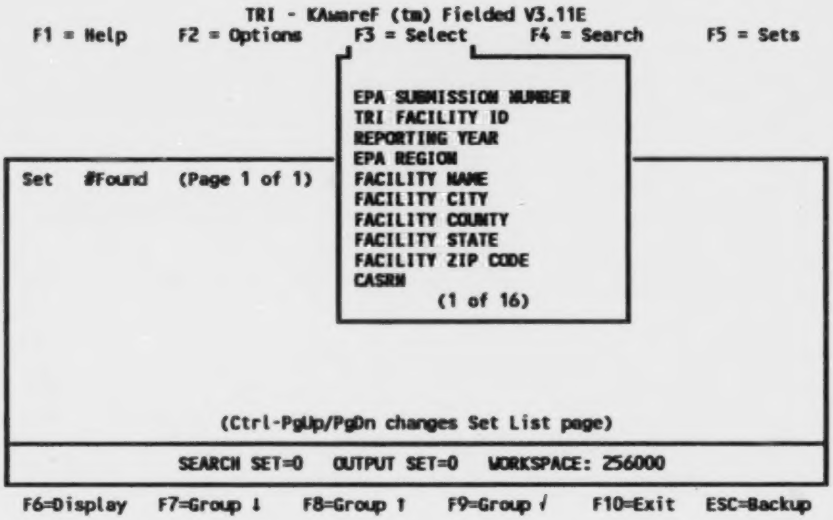
NOTE: To obtain all the data for a single record, you must search both data files (RELEASES and TREATMNT), either by searching by the EPA submission number or using the same search criteria, if it is based on data elements common to both files. The EPA submission number is the unique record identifier that links records from the two files together. Common data elements that can be used to search both files include all facility information, chemical name and CAS number, and reporting year. To make the search easier, when you have completed the search with the first file, print the screen with the set list (using the print screen key on the keyboard). You can then use this print screen copy to duplicate the search for the other remaining file. The TRI software does not provide a way to merge data from the RELEASES and TREATMNT files to create a single, consolidated file. Instead, you can export the same records from each file in the same format and merge them using dBase or other software.

After you have selected a specific data file by pressing **<ENTER>**, the **TRI DATA FILES MAIN MENU** associated with the file that you have chosen is displayed automatically. If you selected the RELEASES file, the following **DATA FILES MAIN MENU** is displayed:



```
                         TRI - KAwareF (tm) Fielded V3.11E
  F1 = Help      F2 = Options      F3 = Select       F4 = Search       F5 = Sets

                                   EPA SUBMISSION NUMBER
                                   TRI FACILITY ID
                                   REPORTING YEAR
                                   EPA REGION
  Set    #Found    (Page 1 of 1)   FACILITY NAME
                                   FACILITY CITY
                                   FACILITY COUNTY
                                   FACILITY STATE
                                   FACILITY ZIP CODE
                                   CASRN
                                             (1 of 88)


                    (Ctrl-PgUp/PgDn changes Set List page)
                          SEARCH SET=0   OUTPUT SET=0
  F6=Display   F7=Group ↓   F8=Group ↑   F9=Group √   F10=Exit   ESC=Backup   F6=Display
```

If you have chosen the TREATMNT file, the following **DATA FILES MAIN MENU** will appear:



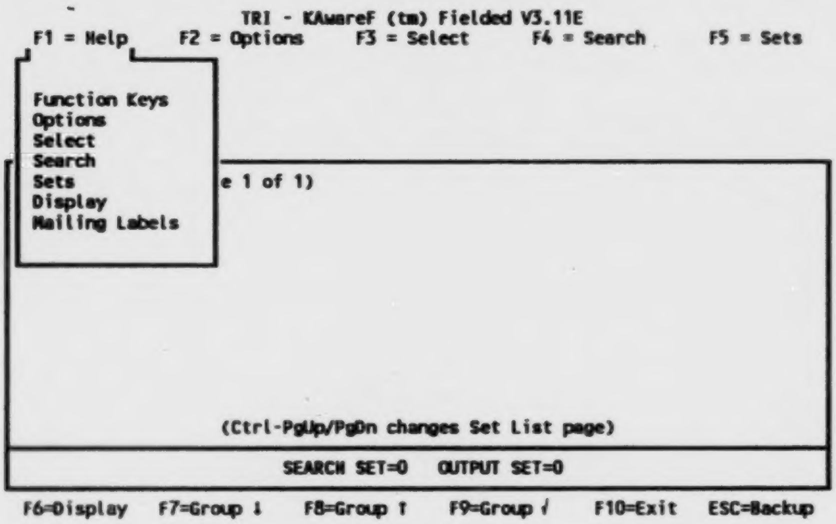
```
                          TRI - KAwareF (tm) Fielded V3.11E
F1 = Help      F2 = Options      F3 = Select       F4 = Search       F5 = Sets

                                 EPA SUBMISSION NUMBER
                                 TRI FACILITY ID
                                 REPORTING YEAR
                                 EPA REGION
 Set    #Found    (Page 1 of 1)  FACILITY NAME
                                 FACILITY CITY
                                 FACILITY COUNTY
                                 FACILITY STATE
                                 FACILITY ZIP CODE
                                 CASRN
                                         (1 of 16)

                        (Ctrl-PgUp/PgDn changes Set List page)

             SEARCH SET=0    OUTPUT SET=0    WORKSPACE: 256000

F6=Display   F7=Group ↓   F8=Group ↑   F9=Group √   F10=Exit   ESC=Backup
```

4.3 Using Function Keys for Searching TRI

Several options in the form of function keys are displayed on the top and bottom of the screen. Some of these options have pull-down menus associated with the them.

NOTE: To remove a pull-down menu associated with a function key option, press the function key for that option and the pull-down menu will toggle off. Press the same function key to toggle the pull-down menu back on.

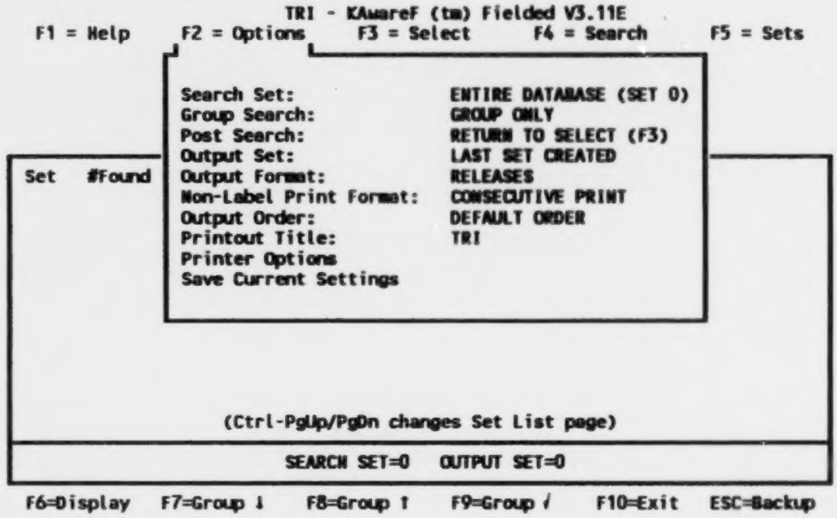
F1 = Help - This option provides context-sensitive help at any time during the program. The HELP option pull-down menu is displayed below:



```
                    TRI - KAwareF (tm) Fielded V3.11E
F1 = Help     F2 = Options     F3 = Select     F4 = Search     F5 = Sets

Function Keys
Options
Select
Search
Sets                 e 1 of 1)
Display
Mailing Labels



               (Ctrl-PgUp/PgDn changes Set List page)
                   SEARCH SET=0   OUTPUT SET=0
F6=Display   F7=Group ↓   F8=Group ↑   F9=Group √   F10=Exit   ESC=Backup
```

The HELP option includes assistance with function keys and their corresponding uses. The HELP option is available at any time while you are in the TRI Data Files by pressing the F1 key. Use the PgUp/PgDn keys to move within the HELP text. Press **<ESC>** to exit from HELP and return to the function that you were using.

F2 = Options - This option allows you to modify the default settings for the search, display, and output features of the retrieval software. The OPTIONS pull-down menu is displayed below:



```
Search Set:                 ENTIRE DATABASE (SET 0)
Group Search:               GROUP ONLY
Post Search:                RETURN TO SELECT (F3)
Output Set:                 LAST SET CREATED
Output Format:              RELEASES
Non-Label Print Format:     CONSECUTIVE PRINT
Output Order:               DEFAULT ORDER
Printout Title:             TRI
Printer Options
Save Current Settings

(Ctrl-PgUp/PgDn changes Set List page)

SEARCH SET=0   OUTPUT SET=0
```

When the cursor is on a specific selection in the OPTIONS menu, press **<ENTER>** to toggle through all of the choices for that selection. To save your selections, use the down arrow to Save Current Settings. Press **<ENTER>**. The new settings will now become the default settings until they are changed again using the F2 key or for that session only using the F5 = Sets key.

F3 = Select and F4 = Search - These options are used to formulate and conduct a search. These keys are explained in greater detail in Section 4.4, Searching For TRI Data.

F5 = Sets - This option allows you to refine your search and presentation of the results by saving and printing the data. Options changed using the F5 key remain changed for that search session only, unlike settings that are changed then saved using the F2 = Options key. See Section 4.5, Refining the Search, for more information.

F6 = Display - This option allows you to view the results of a search record by record. It is described in more detail in Section 4.6, Displaying Search Results.

F7 = Group ↓, F8 = Group ↑ and F9 = Group ✓ - These options allow you to indicate specific terms from the index in order to refine your search. For a detailed description of how to use these options, see Section 4.4.1, Indexing of Data.

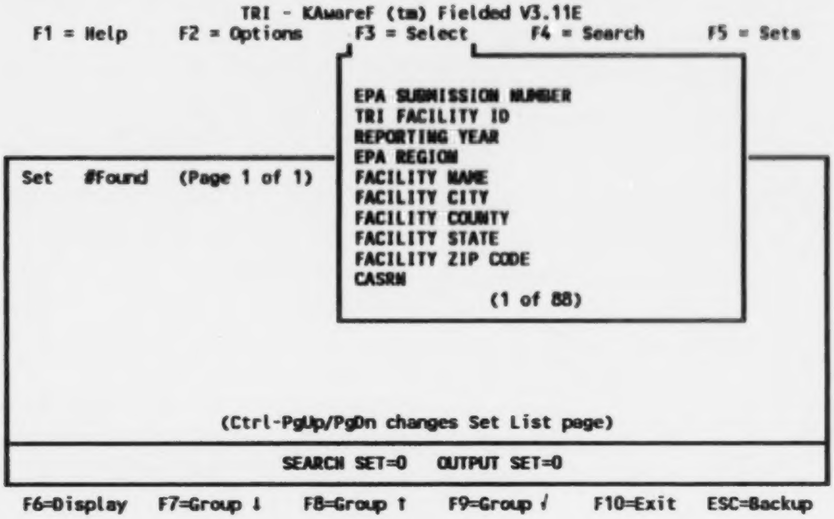
<u>F10=Exit</u> - If you press F10 at any time during a search session, a dialog box will appear with the message "Are you sure you want to exit? (Y/N)" Press <Y> to exit TRI and return to the **DATA BASE SELECTION MENU**. Press <N> to return to the **TRI DATA FILES MAIN MENU**.

<u>ESC=Backup</u> - This option will return you to the previous screen.

4.4 Searching For TRI Data

Searching for TRI data is the primary function for using the TRI system. Conducting a search is a two-step process. First, you need to determine which field or fields in the data base to search and then indicate the values of the fields that you identified. For example, you might decide to search by facility city. You would then indicate that "Boston," for example, is the city for which you are searching. The keys that you would use to accomplish these two steps are F3 = SELECT and F4 = SEARCH, respectively.

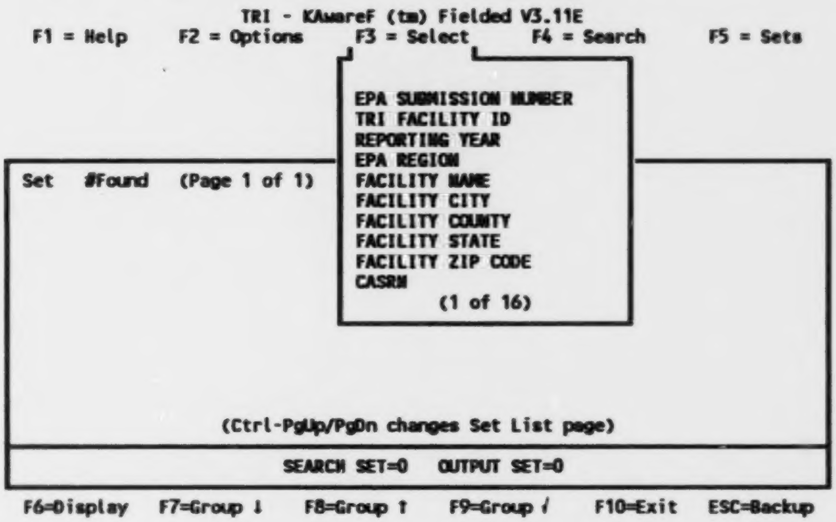
<u>F3 = Select</u> - This option displays all of the fields used to search for data in the TRI data files. The SELECT menu for the RELEASES file is displayed below:



```
                    TRI - KAwareF (tm) Fielded V3.11E
F1 = Help     F2 = Options     F3 = Select      F4 = Search      F5 = Sets

                               EPA SUBMISSION NUMBER
                               TRI FACILITY ID
                               REPORTING YEAR
                               EPA REGION
Set   #Found   (Page 1 of 1)   FACILITY NAME
                               FACILITY CITY
                               FACILITY COUNTY
                               FACILITY STATE
                               FACILITY ZIP CODE
                               CASRN
                                           (1 of 88)

                (Ctrl-PgUp/PgDn changes Set List page)
                    SEARCH SET=0   OUTPUT SET=0
F6=Display   F7=Group ↓   F8=Group ↑   F9=Group √   F10=Exit   ESC=Backup
```

The RELEASES SELECT option lists 88 fields that may be used to build search criteria. Searchable fields include the reporting year; facility name; facility location by zip code, city, county, or state, etc.; chemical name; release medium, i.e., air, water, etc.; amount of releases (in pounds); and many other fields. Use the PgDn key to scroll through all of the search field choices.

The **SELECT** menu for the TRI TREATMNT data file is displayed below:



```
                    TRI - KAwareF (tm) Fielded V3.11E
F1 = Help    F2 = Options    F3 = Select    F4 = Search    F5 = Sets

                            EPA SUBMISSION NUMBER
                            TRI FACILITY ID
                            REPORTING YEAR
                            EPA REGION
Set   #Found   (Page 1 of 1) FACILITY NAME
                            FACILITY CITY
                            FACILITY COUNTY
                            FACILITY STATE
                            FACILITY ZIP CODE
                            CASRN
                                  (1 of 16)

              (Ctrl-PgUp/PgDn changes Set List page)
                  SEARCH SET=0   OUTPUT SET=0
F6=Display  F7=Group ↓  F8=Group ↑  F9=Group √  F10=Exit  ESC=Backup
```

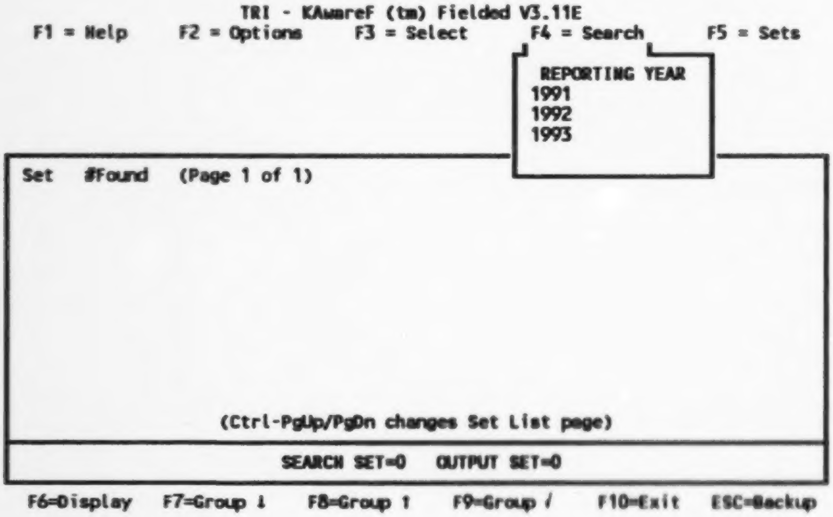
There are a smaller number of fields to search for information with the TREATMNT file than with the RELEASE file. For the TREATMNT file, the SELECT option lists 16 fields for use in building search criteria. Identifying information about the facility, e.g., its name, address, etc., is included in both files (RELEASES and TREATMNT)for searching across files to obtain an entire record. Use the PgDn key to scroll through all of the search field choices.

F4 = Search - This option is directly related to the choices highlighted in the pull-down menus for the F3 = Select option. When you designate F3 = Select and choose a field, the TRI software will automatically present the corresponding pull-down menu for option F4 = Search. These two options are the core of the searching capabilities for the TRI Data Files. To leave this option, press <ESC>.

There are numerous fields for searching and various pull-down menus associated with specific search fields. Two sample fields are shown below to explain the searching capabilities of the TRI software. The first example appears in both the RELEASES and TREATMNT files:

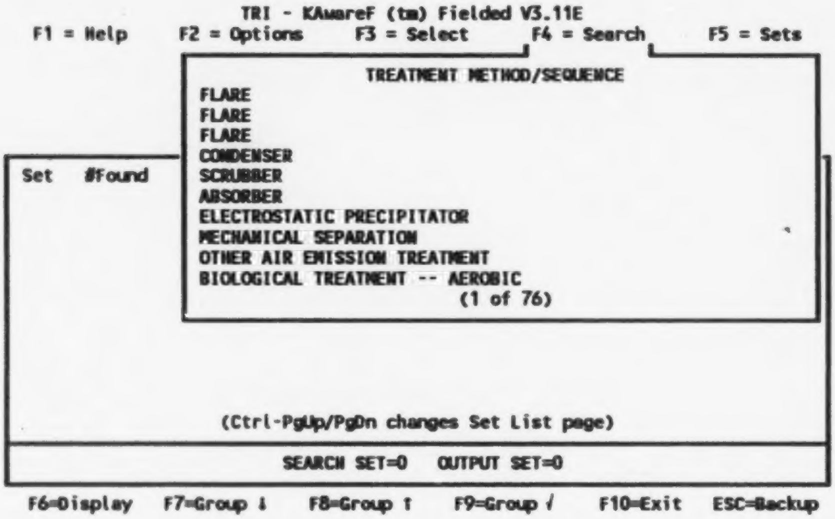
> REPORTING YEAR - This choice provides the option to select from the reporting years for which data is available. Use the down arrow to identify reporting year on the pull down menu for F3 = Select and press **<ENTER>**. The F4 = Search menu listing all of the reporting years available on the disc in use will appear automatically (see screen below). Use the down arrow again to highlight 1993 as the year of choice (if you are using Disc Two) and press **<ENTER>**.

(Note that searching by reporting year is slower than most other searches because it will retrieve about 80,000 records for any given year if you are searching the entire data base. However, it is very useful if you are interested in calculating total annual releases by chemical substance or if you are using the reporting year to narrow an earlier search. See 4.5, Refining the Search.)



```
                     TRI - KAwareF (tm) Fielded V3.11E
F1 = Help     F2 = Options     F3 = Select     F4 = Search      F5 = Sets
                                              REPORTING YEAR
                                              1991
                                              1992
                                              1993
Set   #Found   (Page 1 of 1)

                  (Ctrl-PgUp/PgDn changes Set List page)
                     SEARCH SET=0    OUTPUT SET=0
F6=Display   F7=Group ↓   F8=Group ↑   F9=Group √   F10=Exit   ESC=Backup
```

TREATMENT METHOD/SEQUENCE - This data element from the TREATMNT file provides a list of 76 types of treatment methods. To search by treatment method, highlight that data element on the pull down menu associated with the F3 = Select function and press <ENTER>. The F4 = Search menu listing 76 types of treatment methods will appear automatically. Use the PgDn key to scroll through the list of methods until you reach, as an example, Reuse As Fuel -- Other. Press <ENTER>.



```
                    TRI - KAwareF (tm) Fielded V3.11E
F1 = Help     F2 = Options     F3 = Select     F4 = Search     F5 = Sets
                        TREATMENT METHOD/SEQUENCE
                FLARE
                FLARE
                FLARE
                CONDENSER
Set   #Found    SCRUBBER
                ABSORBER
                ELECTROSTATIC PRECIPITATOR
                MECHANICAL SEPARATION
                OTHER AIR EMISSION TREATMENT
                BIOLOGICAL TREATMENT -- AEROBIC
                                    (1 of 76)

              (Ctrl-PgUp/PgDn changes Set List page)
                   SEARCH SET=0   OUTPUT SET=0
F6=Display  F7=Group ↓  F8=Group ↑  F9=Group √  F10=Exit  ESC=Backup
```

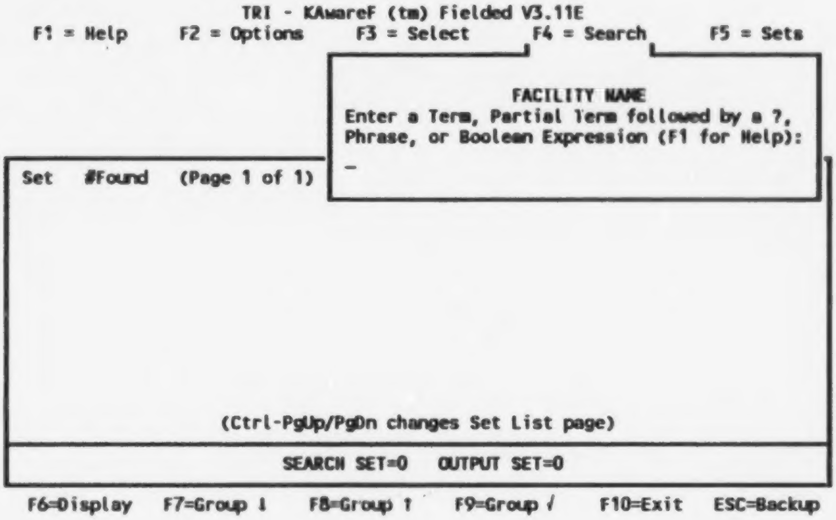
NOTE: Some search tables display a search term or phrase more than once. Always choose the first occurrence, as the second and third occurrences will result in a null set.

4.4.1 Indexing Of Data

The two examples above illustrate searches where the value that you are seeking is selected from a table that displays a limited number of choices, for example, the years 1987-1990 or 1991-1993. However, there will also be instances when you will want to enter the value by which to search from the keyboard.

For many fields, the software allows you to type a term, partial term (followed by a question mark (?)), phrase, or boolean expression. This is possible because every word in the data base has been indexed. The example below illustrates this capability.

FACILITY NAME - To search by facility name, use the down arrow to highlight facility name on the F3 = Select menu and press **<ENTER>**. The pull down menu for F4 = Search appears:



```
                    TRI - KAwareF (tm) Fielded V3.11E
F1 = Help    F2 = Options    F3 = Select    F4 = Search    F5 = Sets

                                    FACILITY NAME
                        Enter a Term, Partial Term followed by a ?,
                        Phrase, or Boolean Expression (F1 for Help):
Set   #Found   (Page 1 of 1)    _

              (Ctrl-PgUp/PgDn changes Set List page)
                   SEARCH SET=0   OUTPUT SET=0
F6=Display  F7=Group ↓  F8=Group ↑  F9=Group √  F10=Exit  ESC=Backup
```

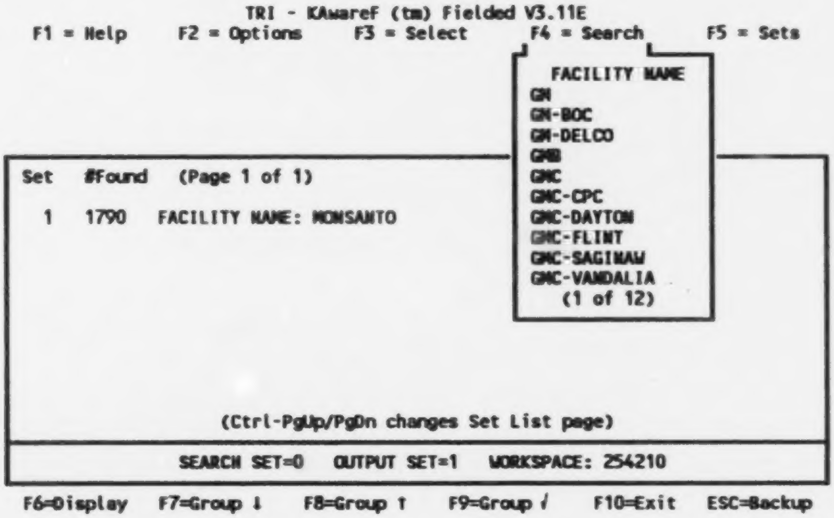
There are two methods to obtain the correct results when searching by facility name.

The first method requires you to know the exact name of the facility. Enter the complete name in the space provided. For example, type **Monsanto** and press **<ENTER>**. The TRI software will search for records where the individual word(s) in the facility name appear in the facility name field exactly the way you typed it (disregarding capitalization) and respond with a set number and the number of records matching the search criteria. If the value that you entered is not found, a box will appear that displays facility names that closely match the characters you have entered. Select the correct name and press **<ENTER>**.

NOTE: Fields are word-indexed only. If you enter a phrase, e.g., "General Electric", the TRI software searches for the words "General" and "Electric." **There is no proximity searching.** Therefore, a search for "General Electric" will retrieve records for "General Electric Co." and "General Dynamics Corp. Electric Boat Div." These two companies are unrelated. When entering multiple words for facility name, you may retrieve records that contain only one of the words in the facility, as well as records for facilities using the complete name. This may also result in retrieval of certain irrelevant records. For example, if you search for **Du Pont Waynesboro Plant**, you will receive all records with either Du Pont or Waynesboro in the facility name. To retrieve records for the Du Pont plant located in Waynesboro only, search first by Dupont then Waynesboro, then combine the two searches using the boolean operator AND (see 4.5, Refining the Search).

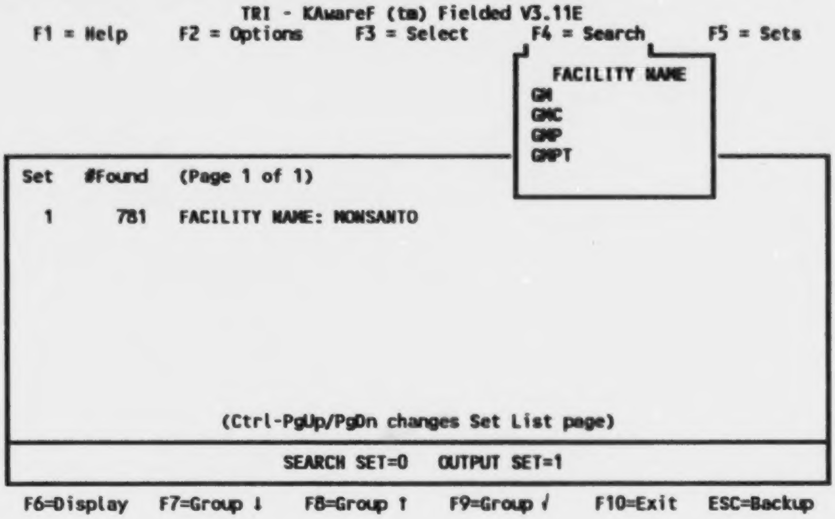
The second method is to use the indexing capability within the TRI software. All fields in the TRI data base files are indexed. When searching for specific data, it is important to use the index feature to assist you. An example of a search where you will benefit from the use of the index is when you are looking for records where a term could consist of many variations. If you are unsure of the spelling of name, the indexing feature will allow you to browse through possible names. To illustrate this feature, suppose you would like to retrieve data on the facility name, "General Motors." First, you should search on the complete name, "General Motors." In addition, there are various abbreviations used for General Motors, such as GM, GMC or General Motors Company. Using the partial term option, type **<GM>** followed by a question mark (?) (e.g., GM?) and press **<ENTER>**. The message, "Searching" appears. A listing of facility names that start with the letters "GM" will appear.

This shows the index entries retrieved by GM? using the 1987-1990 disc:



```
                       TRI - KAwareF (tm) Fielded V3.11E
F1 = Help     F2 = Options     F3 = Select     F4 = Search      F5 = Sets
                                                FACILITY NAME
                                                GM
                                                GM-BOC
                                                GM-DELCO
                                                GMB
Set   #Found   (Page 1 of 1)                    GMC
                                                GMC-CPC
  1   1790   FACILITY NAME: MONSANTO            GMC-DAYTON
                                                GMC-FLINT
                                                GMC-SAGINAW
                                                GMC-VANDALIA
                                                  (1 of 12)

                (Ctrl-PgUp/PgDn changes Set List page)

          SEARCH SET=0   OUTPUT SET=1   WORKSPACE: 254210
F6=Display   F7=Group ↓   F8=Group ↑   F9=Group √   F10=Exit   ESC=Backup
```

Here is the list retrieved by the same search term (GM?) for the 1991-1993 disc:



```
                    TRI - KAwareF (tm) Fielded V3.11E
  F1 = Help    F2 = Options    F3 = Select    F4 = Search    F5 = Sets
                                                FACILITY NAME
                                              GM
                                              GMC
                                              GMP
                                              GMPT
 Set   #Found   (Page 1 of 1)

   1      781   FACILITY NAME: MONSANTO

               (Ctrl-PgUp/PgDn changes Set List page)
                    SEARCH SET=0   OUTPUT SET=1
 F6=Display  F7=Group ↓   F8=Group ↑   F9=Group √   F10=Exit  ESC=Backup
```

Since there are many variations for the term GM, you can use the grouping capability in the TRI software to group together all the GM information you need. The function keys, F7, F8, and F9 are used to group terms together. You would use the grouping keys when you have decided what information is needed.

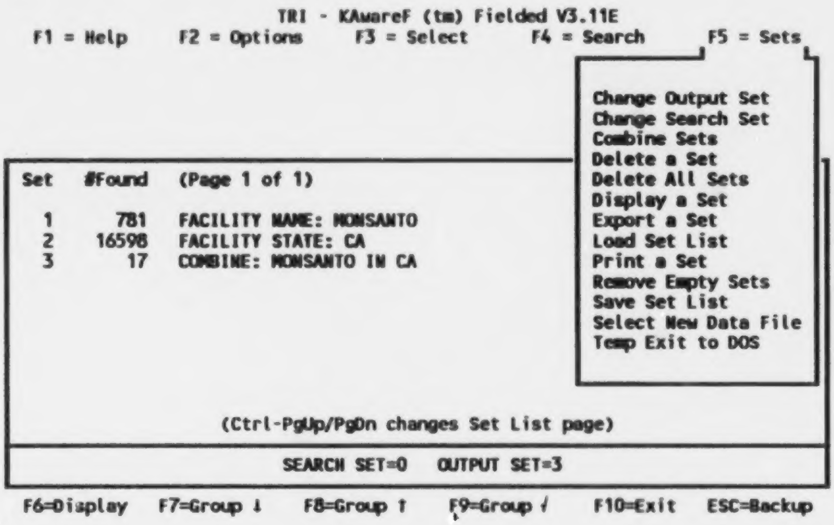
<u>F7=Group ↓, F8=Group ↑, F9=Group ✓</u> - These options are used to search for specific data when you want to group searched terms together or to identify a specific term to retrieve.

To mark the beginning of a range of consecutive terms, move the highlight bar with the up and down arrows on the keyboard to the first term to start the range and press **<F7>**. A down arrow will appear next to the item. In our example of the GM terms for 1987-1990, mark *GM* with the F7 key. Move the highlight bar to the last item in the range that you want and press **<F8>**. An up arrow will appear next to that item. In our example, mark *GMC-Vandalia* with the F8 key. All the items contained between this range will be searched and listed individually or combined into sets. If you need to select items individually that are not listed consecutively, highlight each individual item using the up and down cursor keys and press **<F9>**. A check mark will appear next to each item selected.

When all items are marked, press **<ENTER>** to begin the search. If you want to expand your search, you can request information on the terms, General or Motor, using the question mark (?) as part of your search criteria. If you create more than one set of search criteria, you can combine these sets together to obtain a complete set. Combining sets is discussed in Section 4.5, Refining the Search.

4.5 Refining the Search

<u>F5 = Sets</u> - This option allows you to enhance the sets of data you create. The SETS pull-down menu is displayed below:



```
                              TRI - KAwareF (tm) Fielded V3.11E
   F1 = Help     F2 = Options     F3 = Select      F4 = Search      F5 = Sets

                                                               Change Output Set
                                                               Change Search Set
                                                               Combine Sets
                                                               Delete a Set
 Set   #Found   (Page 1 of 1)                                  Delete All Sets
                                                               Display a Set
  1      781    FACILITY NAME: MONSANTO                        Export a Set
  2    16598    FACILITY STATE: CA                             Load Set List
  3       17    COMBINE: MONSANTO IN CA                        Print a Set
                                                               Remove Empty Sets
                                                               Save Set List
                                                               Select New Data File
                                                               Temp Exit to DOS


                        (Ctrl-PgUp/PgDn changes Set List page)

                             SEARCH SET=0   OUTPUT SET=3

 F6=Display   F7=Group ↓    F8=Group ↑    F9=Group √    F10=Exit   ESC=Backup
```

There are various selections for this option which assist you in creating, printing, and displaying sets. Several examples are displayed below.

> <u>Change Output Set</u> - This selection changes the output set number, that is, the set that will be displayed on the screen when you press F6=Display to display a record. The current output set number appears at the bottom of the screen (above the function key options). The set number entered must be zero or correspond to a set that you have already created. Zero (0) will cause the first record in the entire data base to be displayed when you press F6. The default setting for the output set number is the last set created (see 4.3, F2 = Options). The output set number changes automatically each time that you conduct a new search (unless it was changed from the default setting using the F2 or F5 key).

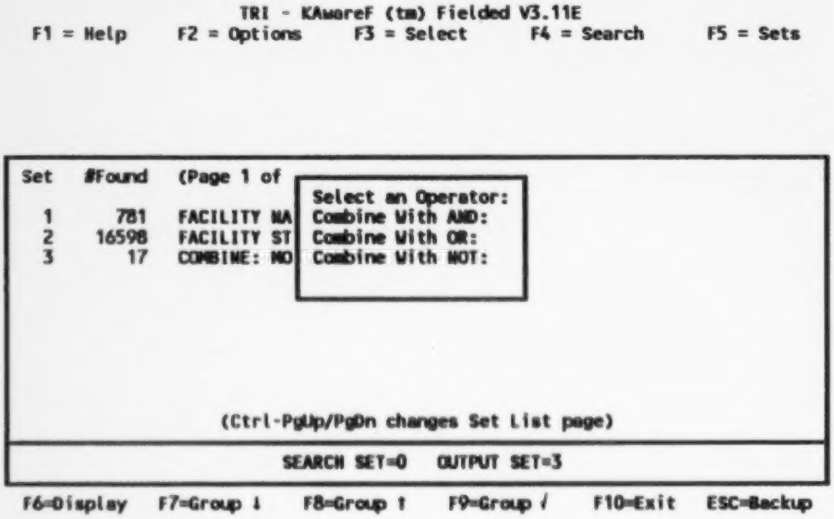
Change Search Set - This selection allows you to change the specific set number to assist in searching for information. If you do not specify a set, the TRI software will search the entire data base file (Search Set=0) . **Once the search set is changed, you must change it back to zero (0) if you wish to resume searching the entire database file.** Using the Change Search Set option saves time and memory space, as the software searches only records contained in the set identified as the search set, not the entire data base. Using the example described previously, you could search for the 1993 reporting year and Monsanto for the facility name. Search for the 1993 reporting year first. Press **<F5>**. Select *Change Search Sets* and press **<ENTER>**. Type the set number you want to search and press **<ENTER>**. Then search for Monsanto. The actual search often takes less time than using the *Combine Sets* option described below.

Combine Sets - This selection allows you to combine user-defined sets with additional conditions of AND, OR, or NOT. You would use this *Combine Sets* option **(Combine with OR)** to combine all the sets that were created in our example of GM in Section 4.4.1. To understand the difference between these three conditions, let us use an example for each condition. For purposes of this example, assume that you have already created one set containing records for facilities reporting releases of the chemical substance benzene and a second set for facilities of the Monsanto Corporation.

- Combine Set 1 (Benzene) AND Set 2 (Monsanto) - The TRI software will search the data base for records meeting both conditions; that is, Monsanto facilities that report releases of the chemical substance benzene.

- Combine Set 1 (Benzene) OR Set 2 (Monsanto) - The TRI software will search the data base and retrieve either records submitted by Monsanto regardless of the chemical substance or records for benzene releases regardless of the source of those releases. Records meeting both conditions would also be retrieved.

- Combine Set 1 (Benzene) but NOT Set 2 (Monsanto) - The TRI software will search the data base for records that meet the first condition but <u>not</u> the second condition. For example, this search would retrieve records identifying benzene releases except for benzene releases reported by Monsanto. **NOTE:** When combining with NOT, you will obtain different results depending on which condition (or set) you specify first.



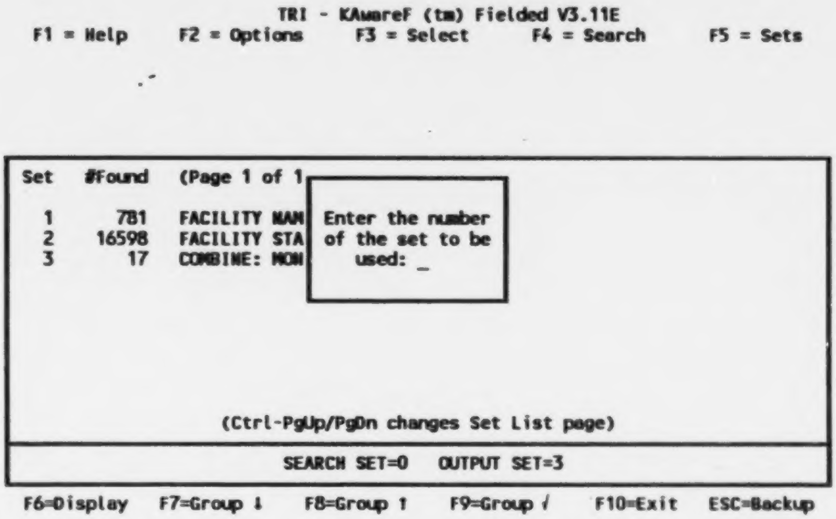
```
                     TRI - KAwareF (tm) Fielded V3.11E
F1 = Help     F2 = Options     F3 = Select     F4 = Search     F5 = Sets


Set   #Found   (Page 1 of
                           Select an Operator:
 1      781    FACILITY NA Combine With AND:
 2    16598    FACILITY ST Combine With OR:
 3       17    COMBINE: NO Combine With NOT:



                (Ctrl-PgUp/PgDn changes Set List page)

                      SEARCH SET=0   OUTPUT SET=3
F6=Display   F7=Group ↓   F8=Group ↑   F9=Group √   F10=Exit   ESC=Backup
```

Select the condition by moving the highlight bar and press **<ENTER>**. Set numbers are displayed on the search screen under the SET category. In the set box, type the first set number, press **<ENTER>**, type the second set number, press **<ENTER>**, etc., until all the set numbers to be combined have been identified. Press **<ENTER>** one additional time. You may give this newly created set a name. If you do not give the set a name, the software will generate a name automatically.

<u>Delete a Set</u> - This selection allows you to delete a specific set. Once you have requested a deletion, that set will be highlighted on the screen to indicate that it has been deleted.

<u>Delete All Sets</u> - This selection allows you to delete all sets containing search results at once. When you use this option, the system will ask you to confirm that you wish to delete all sets. If you answer YES by typing **<Y>** to the erasure of all sets, you will no longer be able to access any user-defined sets. All user-defined sets will have to be recreated. If you answer NO by typing **<N>**, no sets will be erased. (To save records for a particular search before deleting all sets, see Section 4.8.1, Exporting Sets.)

Display a Set - This selection allows you display any user-defined set.



```
                         TRI - KAwareF (tm) Fielded V3.11E
F1 = Help     F2 = Options     F3 = Select     F4 = Search     F5 = Sets

Set   #Found   (Page 1 of 1
                             Enter the number
 1       781   FACILITY NAM  of the set to be
 2     16598   FACILITY STA     used: _
 3        17   COMBINE: MON

               (Ctrl-PgUp/PgDn changes Set List page)

                     SEARCH SET=0   OUTPUT SET=3
F6=Display  F7=Group ↓  F8=Group ↑  F9=Group √  F10=Exit  ESC=Backup
```

Type the number of the user-defined set to be displayed and press **<ENTER>**. If the set number you have entered does not correspond with a set number displayed, the field in the box erases the value you have entered and displays a blank. Enter the correct set number.

Export a Set - This selection allows you to export a set to be used with other software. Six format options are provided: 1) comma-delimited; 2) fixed field; 3) dBase; 4) Lotus; 5) WP Merge; and 6) print-to-disk. (For a more detailed description of each of these formats and how to use the export function, see Section 4.8.1, Exporting Sets.) Enter the number of the set to be saved for exporting and the path and file name, if it is to be saved on the hard disk. If you wish to save the file to a drive other than the hard disk, enter the drive letter as well. A message will appear telling you the set has been saved.

Load Set List - This selection allows you to load a set list that you have previously saved. When you load a set list, the current set list will be erased unless it was previously saved. Enter the path and file name for the set list that you wish to load and press **<ENTER>**. The set list will appear on the screen just as though you had just finished searching the data base. (See Save Set List on the following page for more information.)

Print a Set - This selection allows you to print a set to a local printer. Enter the set number to be printed. You may print complete records or selected fields from the records in the set. You may also sort the records by designated data elements. (See Section 4.7, Printing Results, for more information.) If the set number you have entered does not correspond to an existing set number, the field in the box erases the value you have entered and displays a blank. Enter the correct set number. The set will be printed on a local printer.

Remove Empty Sets - This selection will rewrite your set list to remove sets that do not contain any records if, for example, you had conducted an unsuccessful search earlier.

Save Set List - This selection allows you to save a set list to any drive so that you can retrieve it at a later date.

It is important to distinguish between *Saving a Set List* and *Exporting a Set*. When you save a set list, you are preserving the search strategies and "record pointers" for earlier retrievals so you can build on them later (e.g., by combining them). When you export a set, you are manipulating the actual records retrieved as a result of conducting a search. Using the earlier example, if you conducted searches for the chemical benzene, then Monsanto facilities, and finally, combined those searches to create a third set, the three searches together would comprise a set list. If you saved the set list, you could later reload the set list and continue the session by creating a fourth set, then a fifth, etc. However, none of the actual TRI records representing benzene, Monsanto, etc., would be saved. To preserve the actual search results, that is the TRI records reported for benzene, Monsanto, etc. you would have to EXPORT each set one set at a time. See also Section 4.8, Downloading TRI Data.

Select New Data File - This selection returns you to the **SELECT DATA FILES SCREEN** to select another data file. Press **<ESC>** to return to the **DATA FILE MAIN MENU**. Exercising this option will cause you to lose any sets that you have already constructed.

Temp Exit to DOS - This selection allows you to temporarily exit to DOS. When you are finished using DOS and wish to return to TRI where you left off, type **<EXIT>** at the DOS prompt and press **<ENTER>**. (NOTE: This selection appears on the screen if Temp Exit to DOS was selected during the installation process.)

4.6 Displaying Search Results

After you have conducted a search, a summary of the search results (including the set number, the number of records found, and a description or name of the search) will appear on the screen. You will notice a status line at the bottom of the screen, which highlights the Search Set, Output Set, and Workspace.

- Search Set - identifies which set is being searched. Search Set = 0 (the default setting) means that the entire database will be searched. It may be changed to narrow a search using the Change Search Set option on the F5 = Sets menu, as outlined in Section 4.5. Remember, if you wish to resume searching the entire data base, you must change the search set back to zero.

- Output Set - identifies which set will be displayed when you press the F6 key. The number of the output set changes automatically each time you conduct a new search, or you may change it to review an earlier search using the Change Output Set option on the F5 = Sets menu, as outlined in Section 4.5.

- Workspace - identifies the amount of free space (in bytes) available for storing search results (without saving sets) during a search session.

If you are satisfied with the search results after viewing the summary, you are ready to view the actual records that resulted from it. Press F6 = Display. Or, if you wish to display results of an earlier search, select F5 = Sets option and the pull-down menu appears. Highlight the Display a Set selection and press **<ENTER>**. Enter the set number and press **<ENTER>**. To view results of an earlier example, enter the set number for facility name = Monsanto.

The third line of the **RECORD DISPLAY SCREEN** (under the function keys F1, F2, etc.) provides the name of the set you are currently reviewing. Directly below it, in the text box, the first record in the set is displayed. The first line indicates the number of the record you are viewing within the total records in that set as well as the line number in the record upon which the cursor is presently resting. These numbers will be helpful as you navigate through the display.

Each TRI record from the RELEASES file and the TREATMNT file requires 18 and 5 screens, respectively, to display in their entirety. Each line of data is preceded by a field name that identifies the information reported. In many instances, the field name is abbreviated. For instance, Facility D & B represents the Dun & Bradstreet Number assigned to the reporting facility. A complete list of the data elements is provided as an appendix to this document and in the Quick Reference Guide distributed with the TRI CD-ROM discs. In addition, definitions for each of the fields are contained on each disc in a file called FIELDS.TRI.)

4.6.1 Reviewing Displayed Data

There are several other options to assist you in reviewing records. These options are provided at the bottom of the screen when a record is displayed. These options are:

- 0-9=Speed - This option allows you to control the speed of reviewing all the records in a set. Type 0 (stop) to 9 (fast) to scroll through the records. You will notice that the records will scroll at different speeds, depending on the number value that you have chosen. Type <0> to stop all scrolling.

- ← →=Change Record - This option allows you to scroll down through the records in a set by using the left arrow or to scroll up by using the right arrow.

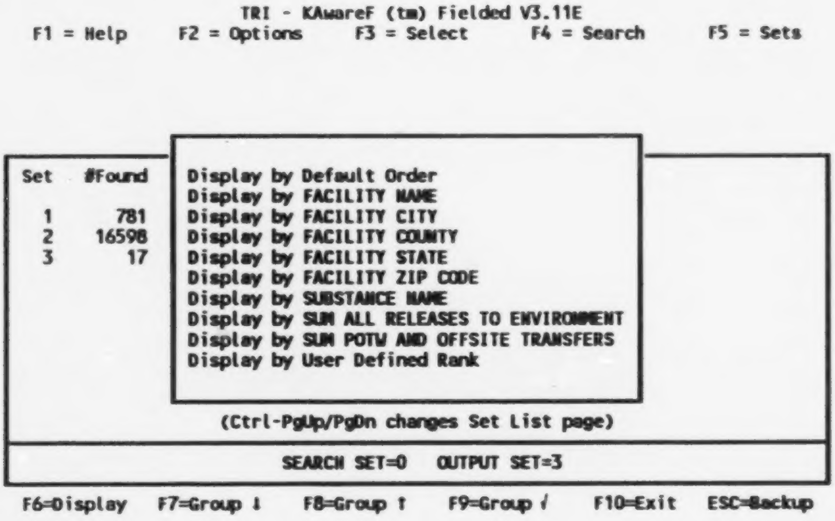
- ↓↑=Scroll Record - This option allows you to scroll through all the data within the record displayed on the screen by using the down arrow to scroll down and the up arrow to scroll up through the record.

4.6.2 Sorting of Data

Sorting data into the order in which you wish to view, print, or download records may be a very important step in making the data more useful to you. For example, you may wish to list reports in descending order by the amount of chemicals that are released into the environment. Or, you may wish to rank all reports submitted for your locality by company name, then by the name of the chemical reported. TRI is very flexible in allowing you to order the output according your criteria.

The example we will use here will walk you through the steps for sorting data when you are preparing to display a set using the Display a Set option on the F5 = Sets pull-down menu. The same sequence of screens appear when you are printing and downloading records or using the Action Menu described in the following section for viewing records.

Select Display a Set using the pull-down menu for F5 = Sets. In response to the screen prompt, enter the number of the set that you would like to sort and press **<ENTER>**. A screen will appear asking you to choose from among 10 options the order in which you would like to have the data displayed. Choosing the first option, Display by Default Order, will result in records sorted by their TRI submission number. (The TRI submission number is a unique identifier assigned to each report as it is received at EPA's EPCRA Reporting Center. It is comprised of 15 alphanumeric characters ending with the state abbreviation.) You may also choose the facility name, its location, the chemical name, or the volume of releases. To make a choice, position the highlight bar over one of the options allowed and press **<ENTER>**.



```
                    TRI - KAwareF (tm) Fielded V3.11E
F1 = Help    F2 = Options    F3 = Select    F4 = Search    F5 = Sets

Set   #Found   Display by Default Order
               Display by FACILITY NAME
 1       781   Display by FACILITY CITY
 2     16598   Display by FACILITY COUNTY
 3        17   Display by FACILITY STATE
               Display by FACILITY ZIP CODE
               Display by SUBSTANCE NAME
               Display by SUM ALL RELEASES TO ENVIRONMENT
               Display by SUM POTW AND OFFSITE TRANSFERS
               Display by User Defined Rank

                 (Ctrl-PgUp/PgDn changes Set List page)

                    SEARCH SET=0   OUTPUT SET=3
F6=Display  F7=Group ↓  F8=Group ↑  F9=Group √  F10=Exit  ESC=Backup
```

The last option on the list, Display By User Defined Rank, offers the greatest flexibility of all. To demonstrate this alternative, position the highlight bar over User Defined Rank and press **<ENTER>.** A list of the field names will be displayed. For each field that you wish to sort by, position the highlight bar over the field name and press **<ENTER>**. Type in a number representing the order by which you wish to sort. For example, if you want to sort first by chemical name (Chem Name) then by the total amount of releases into the environment (Sum All Releases), type 1 next to Chem Name and 2 next to Sum All Releases. To sort Sum All Releases in descending order (highest releases to lowest releases), type 1 next to Chem Name and -2 next to Sum All Releases. Finally, use the up arrow to position the highlight bar over End Rank Selections at the top of the list of data elements and press **<ENTER>**. The TRI system will then sort the data.

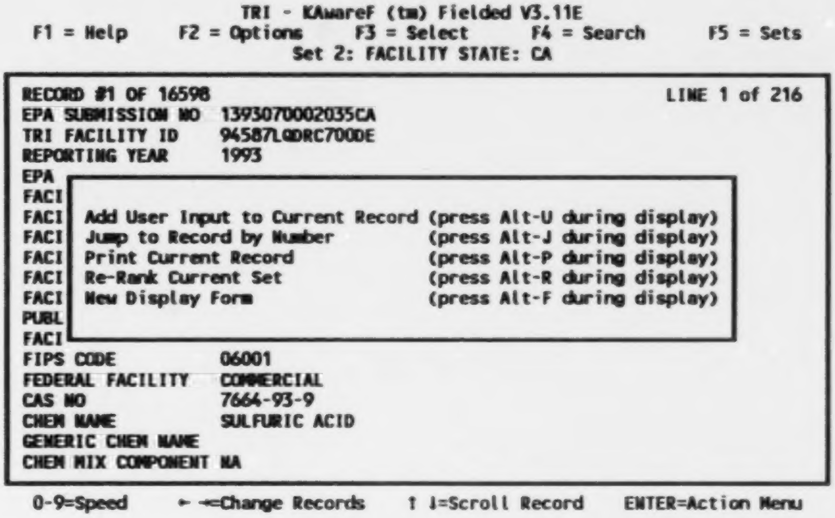
Once you have sorted the data, you can select to view:

- RELEASES (all the fields in the record including blanks)
- RELEASES - BRIEF (all fields in the record containing data)
- USER SELECTED OUTPUT (gives you a list of fields that can be printed or viewed. Using the cursor, highlight the first field that you would like to view and press **<ENTER>**. Press **<ENTER>** to accept the number shown, or enter a new number and press **<ENTER>**. Repeat this step for each field you would like to include, incrementing the number assigned to each field (1, 2, 3, etc.). When you have finished selecting fields, highlight End Output Selections at the top of the field list and press **<ENTER>**.)

Make your selection and press **<ENTER>**.

4.6.3 Action Menu

When you display a set, there are several options available to enhance the display of the data. These options are available using the **ACTION MENU** which is accessed by pressing **<ENTER>** while you are viewing a TRI record on the screen.

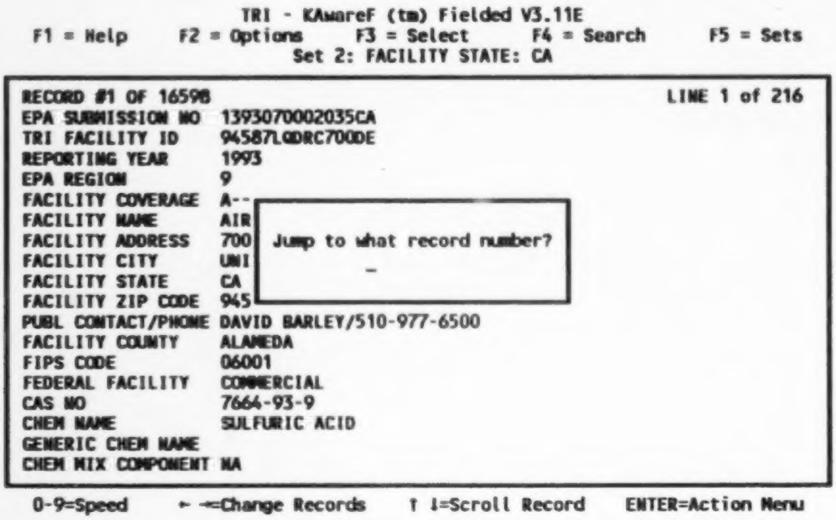


```
                     TRI - KAwareF (tm) Fielded V3.11E
F1 = Help    F2 = Options    F3 = Select    F4 = Search     F5 = Sets
                        Set 2: FACILITY STATE: CA

RECORD #1 OF 16598                                      LINE 1 of 216
EPA SUBMISSION NO  1393070002035CA
TRI FACILITY ID    94587LQDRC700DE
REPORTING YEAR     1993
EPA
FACI
FACI  Add User Input to Current Record (press Alt-U during display)
FACI  Jump to Record by Number         (press Alt-J during display)
FACI  Print Current Record             (press Alt-P during display)
FACI  Re-Rank Current Set              (press Alt-R during display)
FACI  New Display Form                 (press Alt-F during display)
PUBL
FACI
FIPS CODE          06001
FEDERAL FACILITY   COMMERCIAL
CAS NO             7664-93-9
CHEM NAME          SULFURIC ACID
GENERIC CHEM NAME
CHEM MIX COMPONENT NA

0-9=Speed     ← →=Change Records    ↑ ↓=Scroll Record    ENTER=Action Menu
```

To perform any of the selections on the **ACTION MENU**, use the up and down arrows to choose one of the selections. Once the highlighted bar is on the correct choice, press **<ENTER>**. You also can activate any of the selections in the **ACTION MENU** by pressing the keys displayed next to the choice. These keys are known as "hot keys." For example, to search, press the **<Alt>** and the **<J>** keys simultaneously to jump to another record. You can use these hot keys to activate a selection directly from the record display without requesting the **ACTION MENU**. If you are using the **ACTION MENU** and do not wish to activate any of the selections, press **<ESC>** to leave the **ACTION MENU**.

<u>Add User Input to Current Record</u> - This option will allow you to enter two 40 character fields to the record you are viewing. When you later display, print, or export a set, you can mark the user-defined fields to be included in the output.

Jump to Record by Number - If you wish to jump to another record within the set, highlight that choice on the Action Menu and press **<ENTER>** or use the "shortcut" keys by pressing the **<ALT>** and **<J>** key simultaneously. The Jump Record box appears:



```
                         TRI - KAwareF (tm) Fielded V3.11E
F1 = Help     F2 = Options     F3 = Select     F4 = Search     F5 = Sets
                          Set 2: FACILITY STATE: CA

 RECORD #1 OF 16598                                          LINE 1 of 216
 EPA SUBMISSION NO   1393070002035CA
 TRI FACILITY ID     94587LQDRC700DE
 REPORTING YEAR      1993
 EPA REGION          9
 FACILITY COVERAGE   A--
 FACILITY NAME       AIR
 FACILITY ADDRESS    700  Jump to what record number?
 FACILITY CITY       UNI
 FACILITY STATE      CA                _
 FACILITY ZIP CODE   945
 PUBL CONTACT/PHONE DAVID BARLEY/510-977-6500
 FACILITY COUNTY     ALAMEDA
 FIPS CODE           06001
 FEDERAL FACILITY    COMMERCIAL
 CAS NO              7664-93-9
 CHEM NAME           SULFURIC ACID
 GENERIC CHEM NAME
 CHEM MIX COMPONENT NA

 0-9=Speed     ← →=Change Records     ↑ ↓=Scroll Record     ENTER=Action Menu
```

Type in the number of the record in the set that you would like to review. As an example, type **<98>** and press **<ENTER>**. The 98th record in the search set will be displayed.

Print Current Record - The current record will print on your local printer.

Re-Rank Current Set - A pop-up menu allows you to choose any one of ten options for changing the order of the records displayed to your screen.

New Display Form - Allows you to choose one of three formats for displaying data. You can choose from RELEASES (all fields, including blanks), RELEASES - BRIEF (omits blank fields), and USER DEFINED OUTPUT (allows you to choose which fields to display).

4.7 Printing Results

You can print a single record or a group of records (sets). Make sure you have a local printer attached to your computer that is turned on and ready to begin printing.

To print a single record, press <ENTER> to display the **ACTION MENU** while viewing a record on the screen. Use the down arrow to select *Print Current Record* and press **<ENTER>**. The current record will print on your local printer.

To print a set of records, use the selections from the F5 = Sets option. Press **<F5>**. Use the down arrow to choose *Print a Set* and press **<ENTER>**. Type the number of the set. Using the example in this text, type the number of one of the sets that you have created and press **<ENTER>**. Indicate the order in which data should appear. When the information appears, use the down arrow to choose one of the three formats and press **<ENTER>**:

- RELEASES (all the fields in the record including blanks)
- RELEASES - BRIEF (all fields in the record containing data)
- USER SELECTED OUTPUT (gives you a list of fields that can be printed. Using the cursor, highlight the first field that you would like to print and press **<ENTER>**. Press **<ENTER>** to accept the number shown, or enter a new number and press **<ENTER>**. Repeat this step for each field you would like to include, incrementing the number assigned to each field (1, 2, 3, etc.). When you have finished selecting desired fields, highlight End Output Selections at the top of the field list and press **<ENTER>**.

Use the down arrow to choose Consecutive Print or One Page At a Time. Check your printer and press **<ENTER>** when you are ready to print. Consecutive Print will result in one record printing after another, without regard to page breaks. Selection of One Page at a Time will cause each record to begin printing at the top of a new page.

4.8 Downloading from TRI

If you would like to download from TRI to reformat data or use it with another software program, you can use one of two methods provided by the TRI software. One way is to EXPORT your sets, using the Export A Set option provided on the F5 = Sets pull-down menu. You can export sets into any one of several widely used formats, including comma delimited (ASCII) format, fixed field, dBASE (.dbf), or Lotus (.wks), or WP Merge (.sec) formats. You can also export data exactly as it appears on the computer screen (print to disk). Each of these formats are described in greater detail below (see 4.8.1).

In addition, the TRI CD-ROM provides a special capability for downloading data according to your particular specifications using a special feature called the Form Designer. (See Section 4.8.2.) Note that you must use the Form Designer, not Export a Set, when downloading data elements from records containing repeating fields. For example, a single facility may report up to six SIC codes representing industries in which it participates. In order to capture all six possible occurrences (not just the first), use the Form Designer and designate all six SIC Codes for inclusion in your report (see Section 4.8.2).

4.8.1 Exporting Sets

We will use the same set example that was used for printing (please refer to Section 4.7, Printing Results to review the example). Press **<F5>** to retrieve the pull-down menu for the F5 = SETS option. Use the down arrow to choose *Export a Set* and press **<ENTER>**. Type the number of one the sets created as an example set and press **<ENTER>**.

The next screen allows you to choose one of following five formats for downloading data:

Comma-Delimited - This format is the most flexible for using with a variety of other software. Data is saved in one long string. Text in each field is enclosed in quotes and fields are separated by comas (for example, "ABC Manufacturing Facility","1065 Davidson Pike","Andersonville","IN""78856-9976","","","Benzene"). The system automatically adds the suffix .csv to the filename that you specify when you save data.

Fixed-Field - Data is saved in one long string. Each field begins in the same position in each record. Unlike comma-delimited format, fields appear in the export set exactly as they are in the TRI record, including blanks at the end of the field (for example, ABC Manufacturing Company   1065 Davidson Pike   Andersonville   IN 78856-9976   Benzene). The system automatically adds the suffix .fff to the filename that you specify when you save data.

dBase - Data is saved in the data base format required by dBase IV programs. (Files created using the dBase export format do not always work with earlier versions of dBase. In order to use dBase III to manipulate data from TRI, create a new format using the Form designer and export the form to be used in dBase III.) The system automatically adds the suffix .dbf to the file name that you specify when you save data. In order to use the Calculate Releases feature, you must first create and export a file in dBase format (see Chapter Five).

Lotus - Data is saved in the spreadsheet format required by Lotus 1-2-3 programs. The system automatically adds the suffix .wks to the file name that you specify when you save data.

WP Merge - This format saves data in the format used by Word Perfect for use as a secondary file for printing form letters, etc. Records contain the codes required by Word Perfect. The system automatically adds the suffix .sec to the file name that you specify when you save the data.

Print to Disk - Data is saved on your disk exactly as it would appear on your screen, including field tags and with each data element beginning on a new line. The system automatically adds the suffix .p2d to the filename that you specify when you save data. An example of the print to disk format is shown below:

FACILITY NAME	ABC Manufacturing Company
FACILITY ADDRESS	1065 Davidson Pike
FACILITY CITY	Andersonville
FACILITY STATE	IN
FACILITY ZIP CODE	78856-9976
PUBL CONTACT/PHONE	
CAS NO	
CHEM NAME	Benzene

After you choose the output format from among the options described above, a screen allowing you to choose the order for sorting the records will appear. Choose one of the ten options allowed. (See 4.6.2 for a more detailed description of the sort options.)

A menu will appear allowing you to choose from among three options:

- RELEASES - Use this option with caution. It saves all fields in the record, including blank fields. The resulting file may be very large, depending on the data format that you have chosen. (For example, a sample file containing 100 RELEASES records in dBase format required 717,981 bytes of disk space.)

- RELEASES (BRIEF) - This format is often preferred for screen displays and the print to disk export option. This choice is not recommended for downloading. It saves only those fields containing data, causing records to vary in content and length from one to another. This may cause a problem later if you try to import the downloaded data into other software.

- USER SELECTED OUTPUT - This option allows you to choose which fields to download. Press **<ENTER>** to display a list of all fields. Using the cursor, highlight the first field that you would like to print and press **<ENTER>**. Press **<ENTER>** to accept the number shown, or enter a new number and press **<ENTER>**. Repeat this step for each field you would like to include, incrementing the number assigned to each field (1, 2, 3, etc.). When you have finished selecting desired fields, highlight End Output Selections at the top of the field list and press **<ENTER>**.

Type the name of the file to export and the path, if it is different than the path currently displayed. As an example, type **<93FILE>** and press **<ENTER>**. The system will add a suffix to the file name based on the format you have chosen for the data.

4.8.2 Form Designer

As described in earlier sections, the TRI software provides two standardized formats for printing and exporting data called RELEASES and RELEASES (BRIEF). You can also create a User Defined Format at the time you are printing or exporting the set. In addition, there is a fourth option which allows you to create your own customized format and save that format to use again and again. This option is called the Form Designer.

It is essential that you use the Form Designer when you wish to download partial records that include fields that occur more than once in a single record. Examples of fields that may occur more than once in a single record are the Standard Industrial Classification (SIC) and SIC Code, both of which may be present up to six times in each record. (To identify other fields with multiple occurrences, refer to the list of fields in the back of the Quick Reference Guide.) If you are downloading complete records, you can use the RELEASES option, but it may require a lot of disk space. If records containing repeating fields such as SIC are downloaded using the RELEASES (BRIEF) option or a User Defined Format (which is different from the Form Designer explained in this section), each record is a different length. When you try to import them into other software, you will find that additional occurrences of fields like the SIC code displace other data, resulting in fields containing the wrong data. The Form Designer prevents this from occurring by saving space for the additional occurrences in each record, regardless of whether or not data are actually present.

If you plan to download data that requires use of the Form Designer, design the form first, before performing the search. (If you have already performed your search, you can use F5 = Sets to Save Set List. After creating the form, use Load Set List to recreate your search in one easy step.) As you create a new form, you will give it a name of your choosing. After you have finished designing the form and exit the Form Designer, you will search the RELEASES or TREATMNT file to create the set that you wish to download. Then, press F5 = SETS, choose Export A Set, and follow the instructions in Section 4.8.1. This time, the form that you created using the Form Designer will appear with the other report formats.

Before you begin to use the Form Designer, you should consider first how you wish the data to appear, as you would when you create a report. It is especially important that you decide which fields the report should include and in what order you would like them listed. You may find it helpful to layout an example of the form first, before actually creating it on the computer.

To illustrate how to use the Form Designer, we will create a Form called "Toxic Releases by Facility and Industry." It will list, for every record in the search set we designate, the name of the reporting facility, the chemical released, the sum of all releases into the environment, and up to six SICs representing industries in which that facility is involved.

In order to use the Form Designer, you must exit the TRI CD-ROM. To exit, press F10. Enter **<Y>** to confirm that you wish to exit the system. Use the down arrow to highlight Quit TRI CD-ROM Disc on the **DATA BASE SELECTION MENU** and press **<ENTER>**.

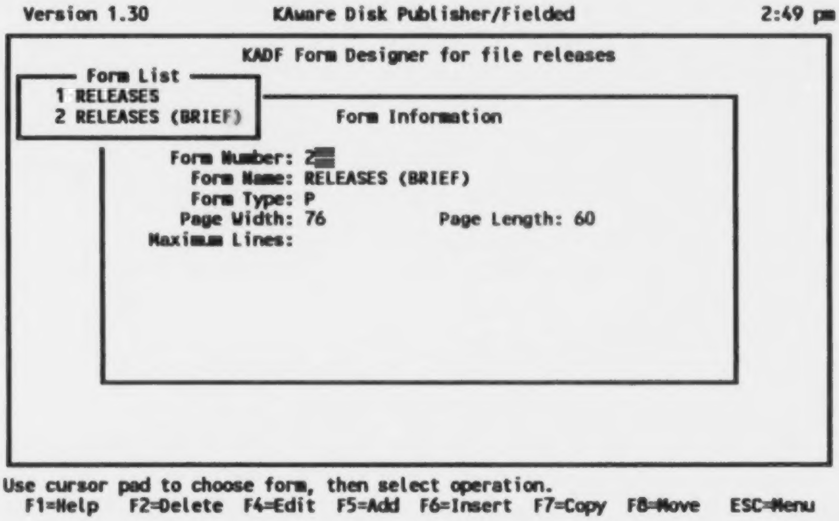
At the DOS prompt, type **KADFDES @** followed by the complete path and the name of the file from which you wish to download data. For example, if you are using the Releases file that was installed in a directory called TRI, it should look like this:

```
C:\TRI>KADFDES @Releases <ENTER>
```

If the form you are designing will contain data from the Treatmnt file and installed, for example, in a directory called TRI, enter:

```
C:\TRI>KADFDES @Treatmnt <ENTER>
```

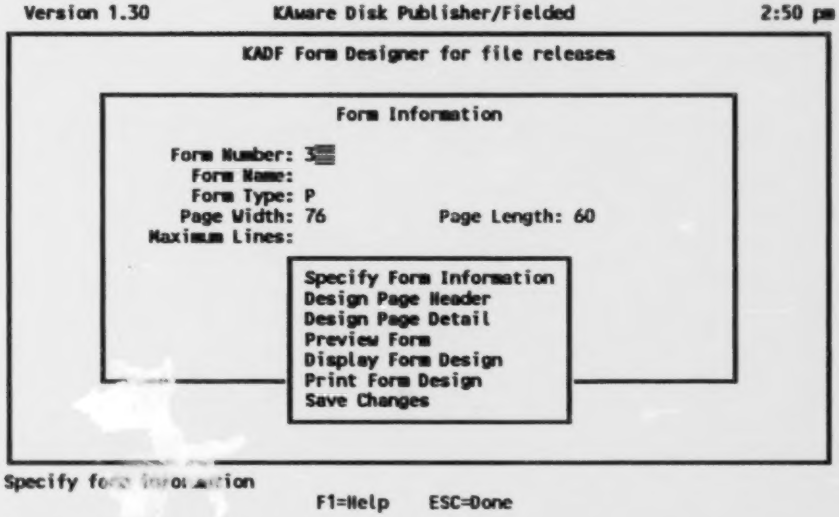
The initial screen for the Form Designer will appear:



```
Version 1.30            KAware Disk Publisher/Fielded                  2:49 pm
                       KADF Form Designer for file releases
  Form List
  1 RELEASES
  2 RELEASES (BRIEF)               Form Information

           Form Number: 2
             Form Name: RELEASES (BRIEF)
             Form Type: P
            Page Width: 76           Page Length: 60
         Maximum Lines:

Use cursor pad to choose form, then select operation.
  F1=Help   F2=Delete  F4=Edit  F5=Add  F6=Insert  F7=Copy  F8=Move   ESC=Menu
```

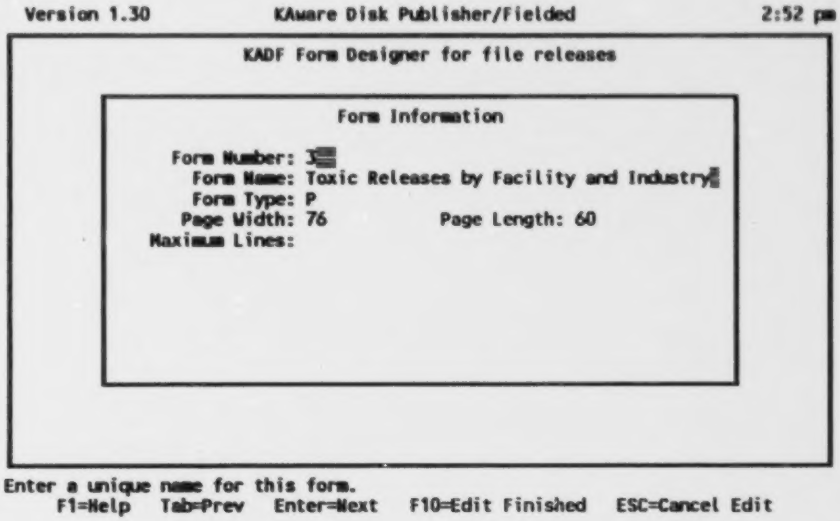
The first time that you use the Form Designer, only the RELEASES and RELEASES (BRIEF) or TREATMNT and TREATMNT (BRIEF) forms will be listed in the text box called the **FORM LIST** in the upper left-hand corner of the screen. After you have used the Form Designer to create your own reports, the names of the forms that you created will be added to the list.

Press **<F5>** to add a new form. A new window will appear in the center of the screen (see below). Following the step-by-step directions provided, you will Specify Form Information, Design Page Detail, Preview Form (if desired), and finally, Save Changes.



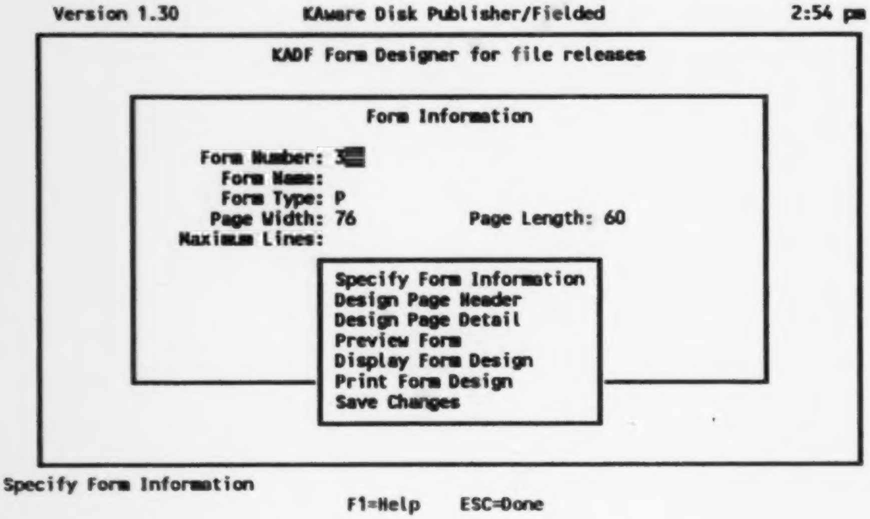
```
Version 1.30          KAware Disk Publisher/Fielded                 2:50 pm
                    KADF Form Designer for file releases

                              Form Information

           Form Number: 3
             Form Name:
             Form Type: P
            Page Width: 76          Page Length: 60
         Maximum Lines:
                          Specify Form Information
                          Design Page Header
                          Design Page Detail
                          Preview Form
                          Display Form Design
                          Print Form Design
                          Save Changes

Specify form information
                           F1=Help    ESC=Done
```

With the cursor highlighting Specify Form Information, press **<ENTER>**. The window will disappear, leaving the screen below. Next to the Form Name, enter the report title as you would like it to appear on your Form and press **<ENTER>**. For this example, we will call our report "Toxic Releases by Facility and Industry." If you plan to use paper measuring something other than 8 1/2" by 11", press **<ENTER>**. You will then have the option of changing the default settings for page width (76 spaces) and page length (60 lines).



```
Version 1.30          KAware Disk Publisher/Fielded                 2:52 pm
                    KADF Form Designer for file releases

                              Form Information

           Form Number: 3
             Form Name: Toxic Releases by Facility and Industry
             Form Type: P
            Page Width: 76          Page Length: 60
         Maximum Lines:

Enter a unique name for this form.
     F1=Help   Tab=Prev   Enter=Next   F10=Edit Finished   ESC=Cancel Edit
```

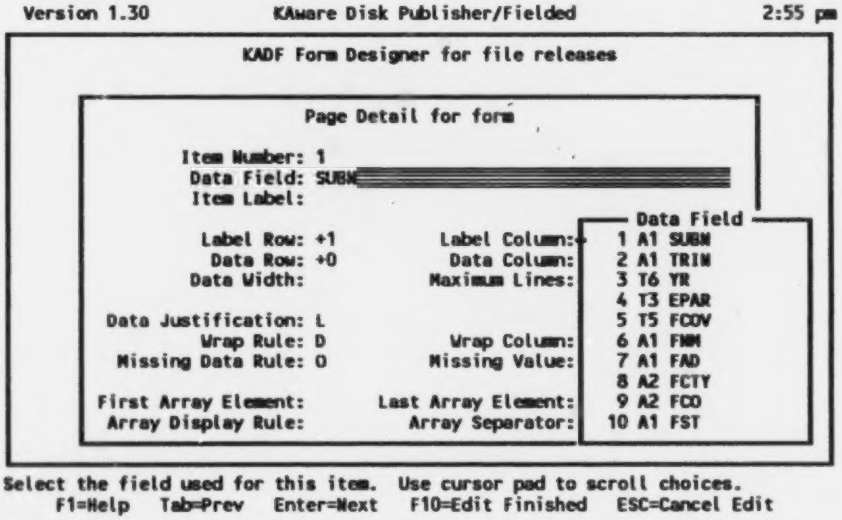
Press **<F10>**. The same window as before reappears in the center of the screen:



```
Version 1.30           KAware Disk Publisher/Fielded                2:54 pm
              KADF Form Designer for file releases

                        Form Information

        Form Number: 3
          Form Name:
          Form Type: P
         Page Width: 76           Page Length: 60
      Maximum Lines:
                     Specify Form Information
                     Design Page Header
                     Design Page Detail
                     Preview Form
                     Display Form Design
                     Print Form Design
                     Save Changes

Specify Form Information
                          F1=Help    ESC=Done
```

Using the down arrow, highlight Design Page Detail and press **<ENTER>**. A new screen, **PAGE DETAIL FOR FORM**, will appear. Press **<ENTER>** and the **PAGE DETAIL LIST** window in the upper left will be replaced by the **DATA FIELD** menu in the lower right. (See the example below.)

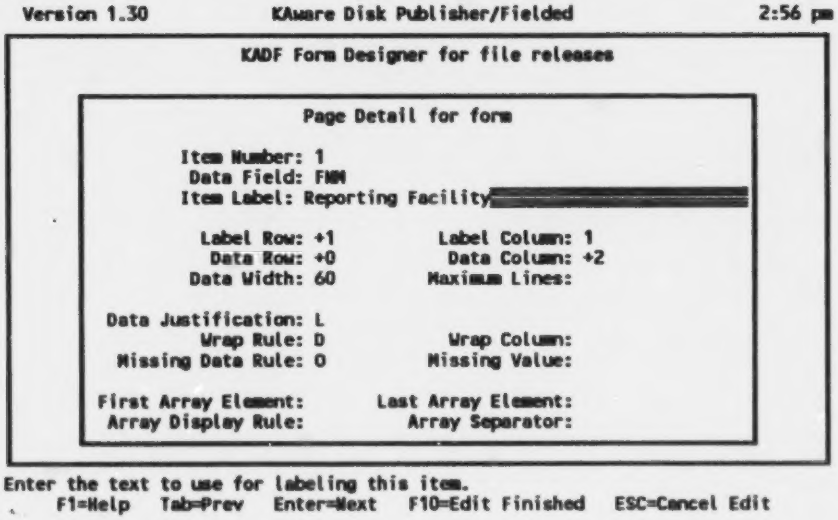
The **DATA FIELD** menu lists a mnemonic tag for each of the data elements in the TRI file that you are using. In order to determine the meaning of a mnemonic tag, you must select it by highlighting it and pressing **<ENTER>**. The complete field name will then appear as the Item Label. If, after viewing the complete field name, you wish to choose another field instead, pres **ESC** and **<ENTER>**. The **DATA FIELD** menu will reappear, allowing you to make another selection. (See Appendix B for a description of each of the fields in the RELEASES and TREATMNT files.)



```
Version 1.30            KAware Disk Publisher/Fielded                2:55 pm

                    KADF Form Designer for file releases

                           Page Detail for form

            Item Number: 1
             Data Field: SUBN
             Item Label:
                                                        Data Field
              Label Row: +1         Label Column:+   1 A1 SUBN
               Data Row: +0          Data Column:    2 A1 TRIN
             Data Width:           Maximum Lines:    3 T6 YR
                                                     4 T3 EPAR
     Data Justification: L                           5 T5 FCOV
              Wrap Rule: D           Wrap Column:    6 A1 FNM
      Missing Data Rule: O         Missing Value:    7 A1 FAD
                                                     8 A2 FCTY
    First Array Element:      Last Array Element:    9 A2 FCO
     Array Display Rule:         Array Separator:   10 A1 FST

Select the field used for this item.  Use cursor pad to scroll choices.
     F1=Help   Tab=Prev   Enter=Next   F10=Edit Finished   ESC=Cancel Edit
```

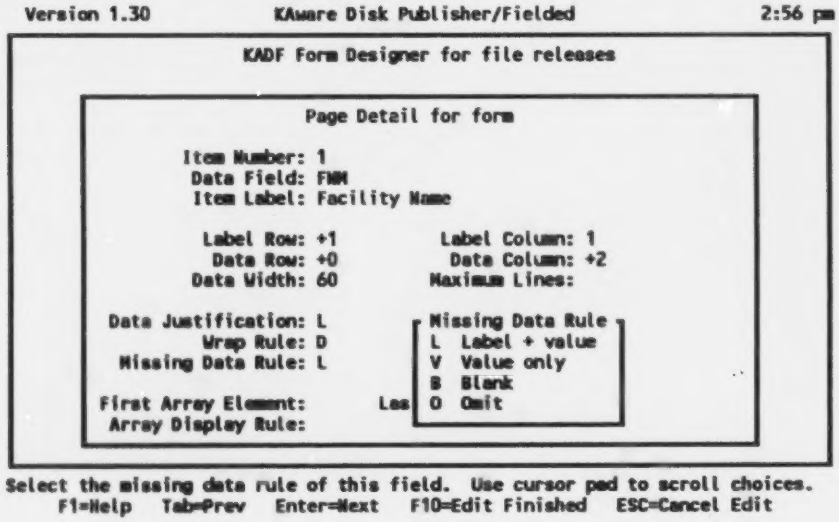
For our example, the first data element we wish to choose is facility name (FNM). To select it, highlight number 6, FNM, and press **<ENTER>**.

The mnemonic tag (FMN) will appear on the screen next to Data Field and Facility Name will be shown as the Item Label. Press **<ENTER>** to accept the Item Label as shown or edit it as you would like it to appear on your report. The screen below shows the Item Label after it was changed from Facility Name to Reporting Facility.



```
Version 1.30           KAware Disk Publisher/Fielded                2:56 pm
            KADF Form Designer for file releases

                       Page Detail for form

             Item Number: 1
              Data Field: FMN
             Item Label: Reporting Facility

               Label Row: +1            Label Column: 1
                Data Row: +0             Data Column: +2
              Data Width: 60           Maximum Lines:

      Data Justification: L
               Wrap Rule: D              Wrap Column:
       Missing Data Rule: O            Missing Value:

     First Array Element:        Last Array Element:
      Array Display Rule:           Array Separator:

Enter the text to use for labeling this item.
      F1=Help   Tab=Prev   Enter=Next   F10=Edit Finished   ESC=Cancel Edit
```

Press **<ENTER>** repeatedly to accept default settings for the row, column, etc. until the cursor is positioned on Missing Data Rule. A pull-down menu highlighting several choices for Missing Data Rule will appear, as shown below:



```
Version 1.30           KAware Disk Publisher/Fielded                2:56 pm
            KADF Form Designer for file releases

                       Page Detail for form

             Item Number: 1
              Data Field: FMN
              Item Label: Facility Name

               Label Row: +1            Label Column: 1
                Data Row: +0             Data Column: +2
              Data Width: 60           Maximum Lines:

      Data Justification: L            ┌ Missing Data Rule ┐
               Wrap Rule: D            │ L  Label + value  │
       Missing Data Rule: L            │ V  Value only     │
                                       │ B  Blank          │
     First Array Element:           Las│ O  Omit           │
      Array Display Rule:              └───────────────────┘

Select the missing data rule of this field.  Use cursor pad to scroll choices.
      F1=Help   Tab=Prev   Enter=Next   F10=Edit Finished   ESC=Cancel Edit
```

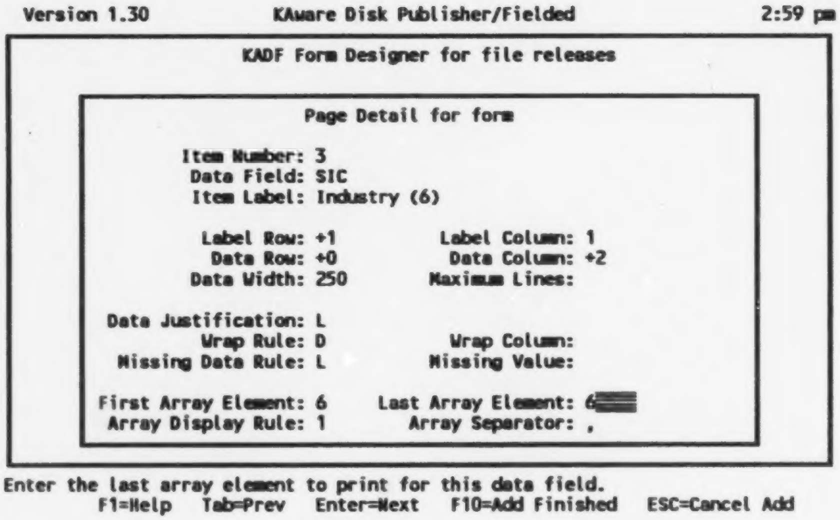
Use the up arrow to move the cursor from O (Omit) to L (Label + value) and press **<ENTER>**. Press **<ENTER>** again to pass Missing Value. That completes the detailed description for Facility Name.

Press **<F5>** to begin describing the second data element that you would like to appear on your report. (Notice that the Item Number changes each time you press **<F5>** to identify a new data element.) To continue with our example, select number 16, NAME, representing the chemical. Follow the steps outlined above. When finished, press **<F5>** and follow the procedure again to enter number 38, SENV (Sum All Releases).

The fourth data element that we identified for our sample report, Standard Industrial Classification (SIC), is a little different because it can occur up to six times in a single record. It is possible to include just selected occurrences, for example, just the first SIC reported, or you can include all of the information, i.e., all six SICs or blank fields. For our report, we decided to include all six SICs.

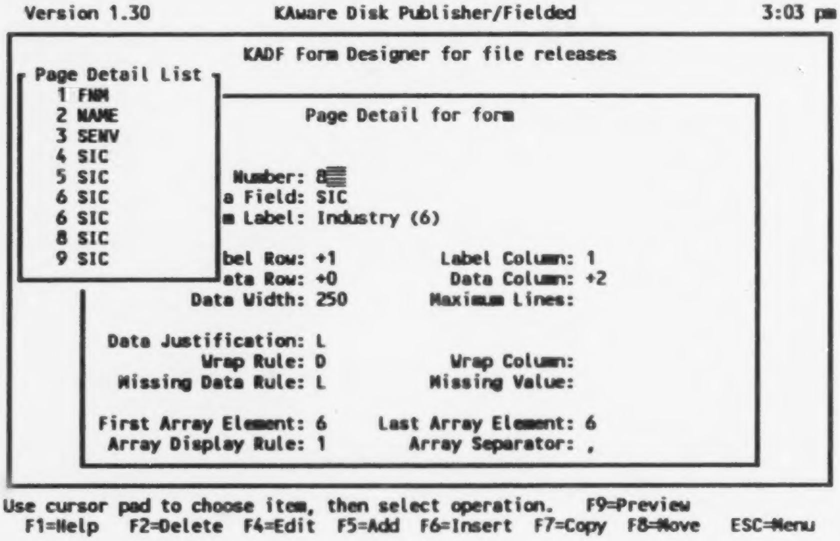
To choose all six, we will need to go through the process of defining SIC, similar to the way we already defined facility name and chemical name, six times. To select SIC, press **<F5>**. Choose number 33, SIC, from the **DATA FIELD** menu. For the Item Label, change Standard Industrial Classification to **Industry (1)** to show that this is the first industrial classification that was reported. Press **<ENTER>** repeatedly until Missing L Rule is highlighted. This time, after you change the field from O (Omit) to L (Label + value) and press **<ENTER>**, the cursor will highlight First Array Element. Press **<ENTER>** to accept 1 (one) as the First Array Element. The cursor will move to Last Array Element. Type **<1>** again and press **<ENTER>**.

Repeat this process five times for the additional SICs, using Industry (2), Industry (3), etc. as the Item Label and changing the First Array Element and Last Array Element to 2, then 3, etc. (See the screen below, which shows the **Page Detail for Form** screen after the data was entered for the sixth SIC. Note the Item Label, First Array Element and Last Array Element all indicate that it is the sixth occurrence for that field.)



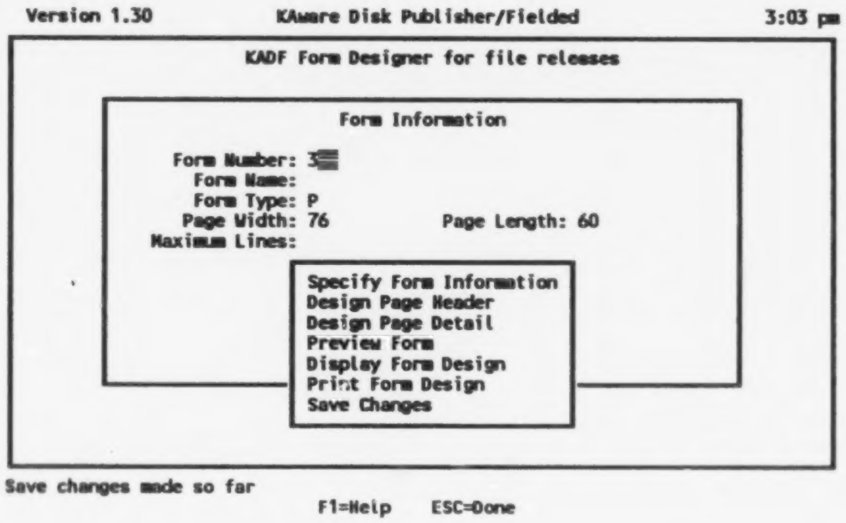
```
Version 1.30              KAware Disk Publisher/Fielded                 2:59 pm

                          KADF Form Designer for file releases

                                  Page Detail for form

                       Item Number: 3
                        Data Field: SIC
                        Item Label: Industry (6)

                         Label Row: +1           Label Column: 1
                          Data Row: +0            Data Column: +2
                        Data Width: 250         Maximum Lines:

               Data Justification: L
                        Wrap Rule: D              Wrap Column:
                Missing Data Rule: L            Missing Value:

              First Array Element: 6     Last Array Element: 6
               Array Display Rule: 1        Array Separator: ,

Enter the last array element to print for this data field.
    F1=Help   Tab=Prev   Enter=Next   F10=Add Finished   ESC=Cancel Add
```

When you have finished, all of the data elements that you wanted on your report should be listed in the box in the upper left hand corner of the screen:



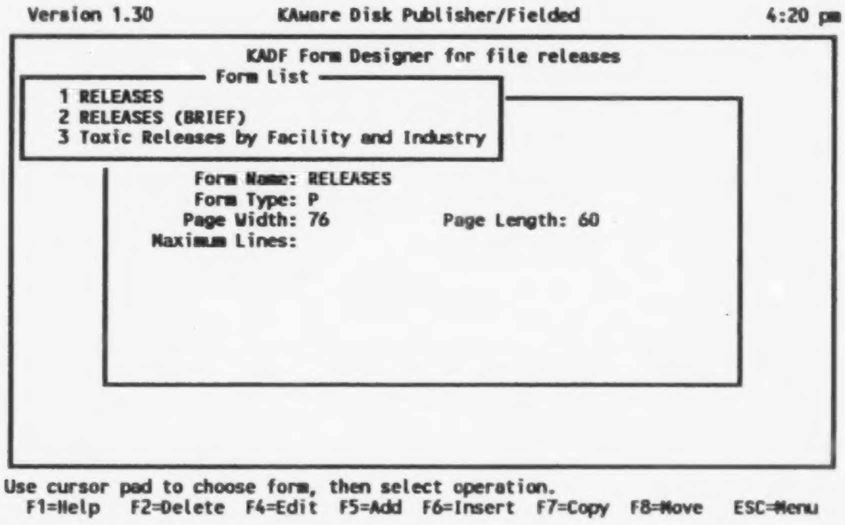
```
Version 1.30              KAware Disk Publisher/Fielded                 3:03 pm

                          KADF Form Designer for file releases
  Page Detail List
    1 FNM
    2 NAME                        Page Detail for form
    3 SENV
    4 SIC
    5 SIC              Number: 8
    6 SIC             a Field: SIC
    6 SIC             m Label: Industry (6)
    8 SIC
    9 SIC             bel Row: +1           Label Column: 1
                      ata Row: +0            Data Column: +2
                    Data Width: 250         Maximum Lines:

               Data Justification: L
                        Wrap Rule: D              Wrap Column:
                Missing Data Rule: L            Missing Value:

              First Array Element: 6     Last Array Element: 6
               Array Display Rule: 1        Array Separator: ,

Use cursor pad to choose item, then select operation.   F9=Preview
  F1=Help   F2=Delete  F4=Edit  F5=Add  F6=Insert  F7=Copy  F8=Move   ESC=Menu
```

After you have verified that all desired data elements were defined, press <ESC>. The menu for entering specifications for your form will reappear in the center of the screen. Move the down arrow to highlight Save Changes and press <ENTER>. You should see the message "Forms being saved..." at the bottom of your screen.



```
Version 1.30            KAware Disk Publisher/Fielded              3:03 pm
                  KADF Form Designer for file releases

                            Form Information

              Form Number: 3
                Form Name:
                Form Type: P
               Page Width: 76           Page Length: 60
            Maximum Lines:

                          Specify Form Information
                          Design Page Header
                          Design Page Detail
                          Preview Form
                          Display Form Design
                          Print Form Design
                          Save Changes

Save changes made so far
                          F1=Help    ESC=Done
```

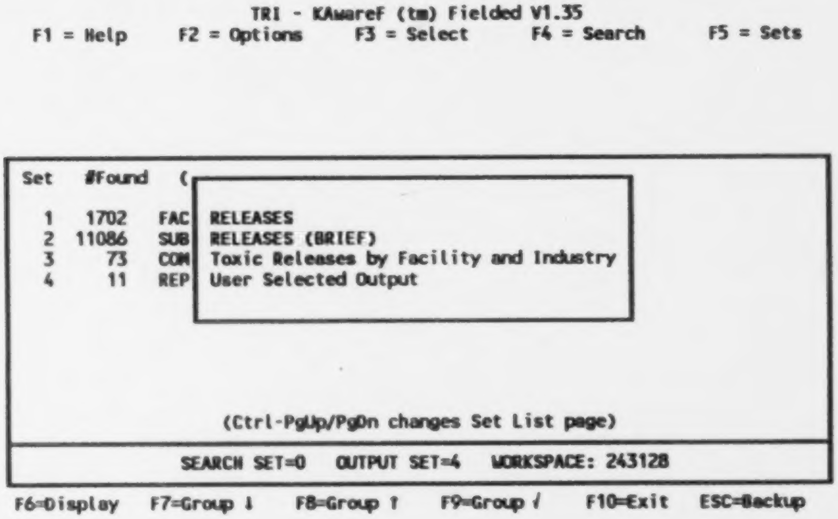
Press **<ESC>**. You will return to the original **FORM DESIGNER SCREEN**. This time, the Form List will include the title of the form that you just created. For our example, the title, "Toxic Releases by Facility and Industry" was added to the Form List, as shown below.



```
Version 1.30            KAware Disk Publisher/Fielded              4:20 pm
                  KADF Form Designer for file releases
                  Form List
     1 RELEASES
     2 RELEASES (BRIEF)
     3 Toxic Releases by Facility and Industry

                Form Name: RELEASES
                Form Type: P
               Page Width: 76           Page Length: 60
            Maximum Lines:

Use cursor pad to choose form, then select operation.
  F1=Help   F2=Delete  F4=Edit  F5=Add  F6=Insert  F7=Copy  F8=Move   ESC=Menu
```

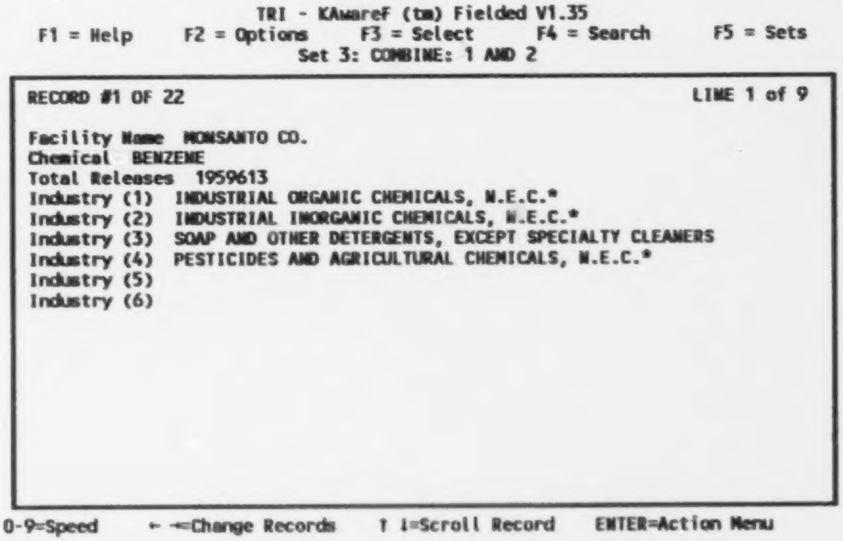
This form is now ready to be used for displaying, printing, or exporting data, in accordance with the instructions provided in Sections 4.6.3, 4.7, and 4.8.1.

Press **<F10>** to exit to DOS. At the DOS prompt, type TRI. This will retrieve the **DATA BASE SELECTION MENU.** Choose **2 Toxics Release Inventory 1991-1993** and you are ready to begin using the TRI data base again. When you have retrieved the **TRI DATA FILES MAIN MENU**, proceed to perform the search that you would like to download or print. Using the F5 = Sets option, choose Export a Set or Print a Set. This time, in addition to the other output formats, the name of your new form will appear:



```
                  TRI - KAwareF (tm) Fielded V1.35
F1 = Help    F2 = Options    F3 = Select    F4 = Search    F5 = Sets

Set   #Found   (
  1    1702   FAC  RELEASES
  2   11086   SUB  RELEASES (BRIEF)
  3      73   COM  Toxic Releases by Facility and Industry
  4      11   REP  User Selected Output

            (Ctrl-PgUp/PgDn changes Set List page)
       SEARCH SET=0   OUTPUT SET=4   WORKSPACE: 243128
F6=Display  F7=Group ↓  F8=Group ↑  F9=Group √  F10=Exit  ESC=Backup
```

Use the down arrow to highlight the name of the form that you created. For our example, we created "Toxic Releases by Facility and Industry". Press **<ENTER>**. Records in the set will be displayed (or printed or exported) in the format that you designed, as the example below illustrates.



```
                  TRI - KAwareF (tm) Fielded V1.35
F1 = Help    F2 = Options    F3 = Select    F4 = Search    F5 = Sets
                    Set 3: COMBINE: 1 AND 2
RECORD #1 OF 22                                        LINE 1 of 9

Facility Name  MONSANTO CO.
Chemical  BENZENE
Total Releases  1959613
Industry (1)  INDUSTRIAL ORGANIC CHEMICALS, N.E.C.*
Industry (2)  INDUSTRIAL INORGANIC CHEMICALS, N.E.C.*
Industry (3)  SOAP AND OTHER DETERGENTS, EXCEPT SPECIALTY CLEANERS
Industry (4)  PESTICIDES AND AGRICULTURAL CHEMICALS, N.E.C.*
Industry (5)
Industry (6)

0-9=Speed   ← →=Change Records   ↑ ↓=Scroll Record   ENTER=Action Menu
```

5.0 Performing Calculations (KASTAT)

The calculation feature (also referred to as KASTAT) is used to compute the total amounts for specific sets of data. With the calculation feature, you must use the RELEASES data file which has numeric fields to retrieve information.

5.1 Calculating Data

KASTAT is a useful feature to obtain total release amounts. We will use the following example to explain this feature. We would like to determine the total amount of chlorine released in 1993 in the state of Delaware. Retrieve the following information first, before using the calculation feature:

- Substance Name - Chlorine
- Facility State - DE
- Reporting Year - 1993

Follow the search and combine instructions to retrieve as set of records for the above described criteria. Review Chapter 4, Toxics Release Inventory, to assist you.

Export the set you have created by performing the following steps:

1. Choose the set number **<ENTER>**.
2. Choose dBASE as the type of export file **<ENTER>**.
3. Choose default order **<ENTER>**.
4. Choose User Selected Output as the output format. Select the fields listed below by entering a sequential number next to each. When you have entered a field number for each of the chosen fields, scroll back to the top of the window that lists all of the field names. Highlight **End User Selections** and press **<ENTER>**.
    - Field 1: Sum Air Releases (SAIR)
    - Field 2: Sum Water Releases (SW)
    - Field 3: Sum Land Releases (SL)
    - Field 4: Sum Underground Releases (SU)
    - Field 5: Sum All Releases to Environment (SENV)
    - Field 6: Sum POTW (Publicly Owned Treatment Works) Transfers (SPOTW)
    - Field 7: Sum Offsite Transfers (SOFF)
    - Field 8: Sum POTW and Offsite Transfers (SPO)
    - Field 9: Sum Releases and Transfers (SRT)

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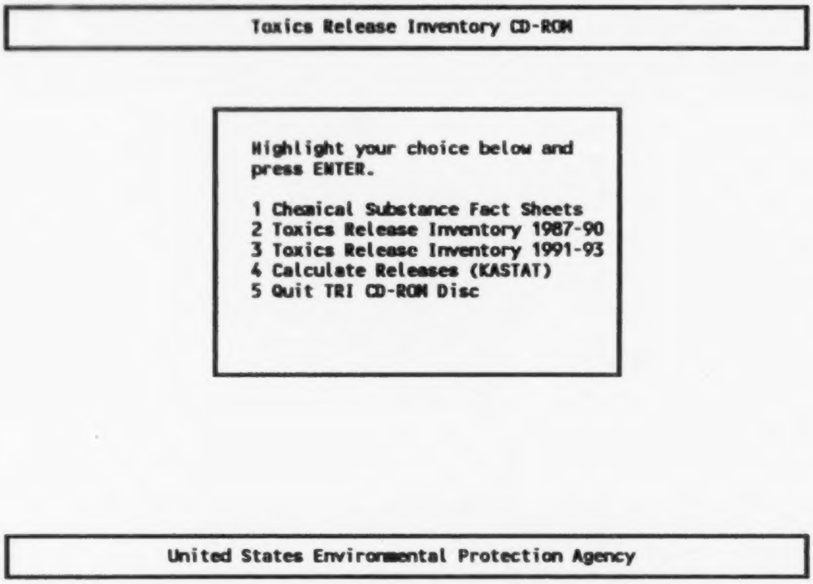
5. Name the file by typing a name and pressing <ENTER> (e.g., a:93DE-CHL.DBF <ENTER>. The filename ending (beginning with the period) must be .DBF or left blank. If it is left blank, the system will supply the ending .DBF).

After the export has taken place, press **<F10>** to exit to the **DATA BASE SELECTION MENU**.

Select **4 Calculate Releases (KASTAT)** from the **DATA BASE SELECTION MENU**. Use the down arrow to highlight Calculate Releases (KASTAT) and press **<ENTER>**.



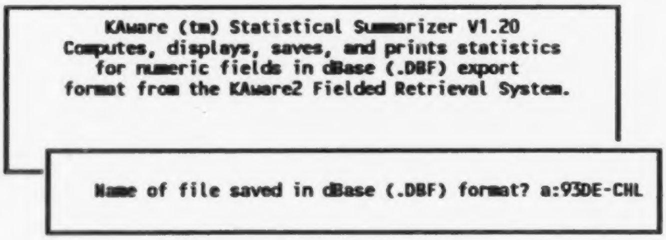
Toxics Release Inventory CD-ROM

Highlight your choice below and
press ENTER.

1 Chemical Substance Fact Sheets
2 Toxics Release Inventory 1987-90
3 Toxics Release Inventory 1991-93
4 Calculate Releases (KASTAT)
5 Quit TRI CD-ROM Disc

United States Environmental Protection Agency

A screen will appear requesting the name of the file containing the records for which you would like to calculate releases. Type the name of the dbase file you just created. (It is not necessary to include the file ending .dbf.)



KAware (tm) Statistical Summarizer V1.20
Computes, displays, saves, and prints statistics
for numeric fields in dBase (.DBF) export
format from the KAware2 Fielded Retrieval System.

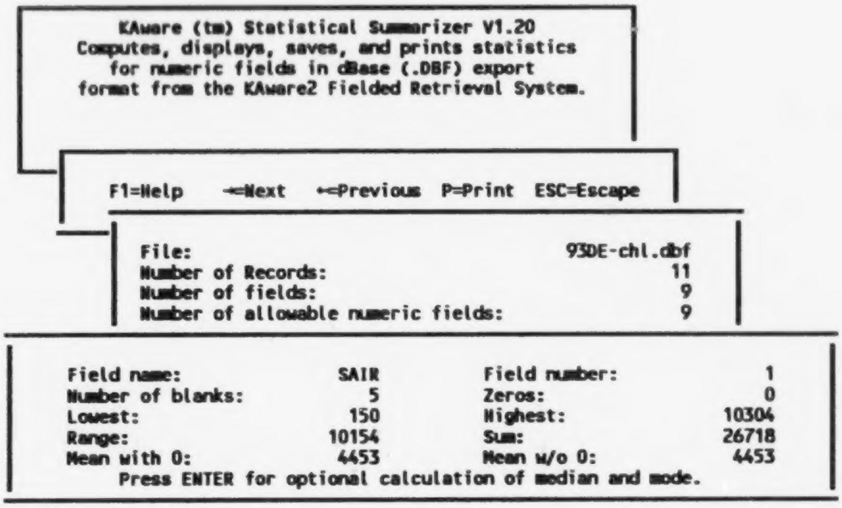
Name of file saved in dBase (.DBF) format? a:93DE-CHL

There is one screen displayed for each field in the dBase file that you created. For our example, which contained nine fields containing numbers representing release amounts, nine screens were generated.

Use the right and left arrows to move from one screen to another. Press **<P>** to print each screen. When calculations are completed, a new file (.ANL) is created containing the screen text. In DOS you can print the screen displays out from the ANL file (e.g., 93DE-CHL.ANL for the example). Or, as the screens are displayed, press **<P>** repeatedly eight times, to receive a hard copy of each screen of information for the eight fields you have selected.

There is no HELP (F1) option available for the KASTAT selection, however, a description of the feature can be viewed or printed from the CD-ROM disc, i.e., L:\>**type KASTAT\KASTAT.TXT.** For a list of field labels for numeric fields that can be used for performing calculations, **type** or **print KASTAT\KASTAT.FLD.**

The first of the nine screens, showing releases to air (SAIR), is shown below.



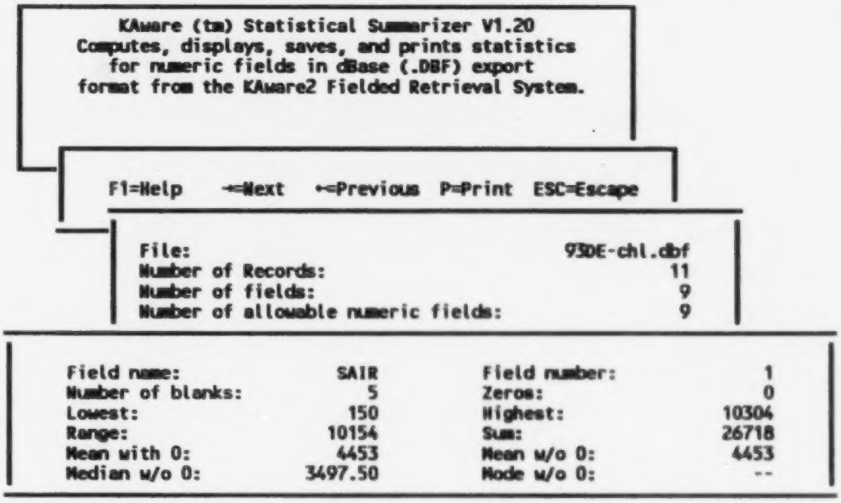
```
            KAware (tm) Statistical Summarizer V1.20
          Computes, displays, saves, and prints statistics
             for numeric fields in dBase (.DBF) export
          format from the KAware2 Fielded Retrieval System.

       F1=Help    →=Next   ←=Previous  P=Print  ESC=Escape

         File:                                  93DE-chl.dbf
         Number of Records:                               11
         Number of fields:                                 9
         Number of allowable numeric fields:               9

    Field name:              SAIR       Field number:           1
    Number of blanks:           5       Zeros:                  0
    Lowest:                   150       Highest:            10304
    Range:                  10154       Sum:                26718
    Mean with 0:             4453       Mean w/o 0:          4453
         Press ENTER for optional calculation of median and mode.
```

Press **<ENTER>.** Two new fields, Mean w/ 0 and Mean w/o 0 are added at the bottom of the screen:



```
         KAware (tm) Statistical Summarizer V1.20
       Computes, displays, saves, and prints statistics
         for numeric fields in dBase (.DBF) export
       format from the KAware2 Fielded Retrieval System.

      F1=Help    →=Next   ←=Previous  P=Print  ESC=Escape

        File:                                    93DE-chl.dbf
        Number of Records:                                 11
        Number of fields:                                   9
        Number of allowable numeric fields:                 9

   Field name:               SAIR      Field number:            1
   Number of blanks:            5      Zeros:                   0
   Lowest:                    150      Highest:             10304
   Range:                   10154      Sum:                 26718
   Mean with 0:              4453      Mean w/o 0:           4453
   Median w/o 0:          3497.50      Mode w/o 0:             --
```

5.2 Defining Records in a KASTAT Record

A brief description of each field (in alphabetical order) is presented below:

Field Name - The field which the calculation was performed on (SAIR - Sum of All Releases).

Field Number - The number of the field that the calculation was performed on (field number 1 is SAIR).

File - The name of the dBASE file that was created (93DE-CHL.DBF).

Highest - The highest single release of Chlorine into the air in pounds (10304).

Lowest - The lowest single release of Chlorine to the air in pounds (150).

Mean with O - The average of the field for which the calculation is being processed, including records reporting 0 (zero) pounds released to air (4453).

Mean W/O 0 - The average of the field for which the calculation is being processed without records containing zeros in that field (4453).

Median w/o 0 - The middle number of the numbers reported for the field for which the calculation is being processed, not including records reporting 0 (zero) pounds released to air (3497.50). For example, if five records are processed, the third number is the median

Mode w/o 0 - The value that occurs most frequently of the numbers that are reported for the field for which the calculation is being processed, not including records reporting 0 (zero) pounds released to air (--).

Number of Allowable Numeric Fields - The number of numeric fields (9).

Number of Blanks - The number of records which had a blank or no data in that field (5).

Number of Fields - The number of fields in the record (9).

Number of Records - The number of records in the set of data for which calculations have been performed (11).

Range - The difference between the highest and the lowest single release (10,304) (Highest) - 150 (Lowest) = 10,154) pounds.

Sum - The total sum of the field on which the calculation is being processed in pounds (26718).

Zeros - The number of zeros in the record (0).

Press **<ESC>** to exit from the **KASTAT** record and to return to the **DATA BASE SELECTION MENU**.

5.3 Special Keys

There are several special keys within the KASTAT option. There is one screen for each field. To move forward through the screens, use the right arrow. To move backward, use the left arrow. You can print each screen of data.

APPENDIX A

(IMPORTANT: Type or print; read instructions before completing form)

Form Approved OMB Number: 2070-0093
Approval Expires: 11/92

Page 1 of 9

EPA
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FORM R TOXIC CHEMICAL RELEASE INVENTORY REPORTING FORM

Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986, also known as Title III of the Superfund Amendments and Reauthorization Act

TRI FACILITY ID NUMBER

Toxic Chemical, Category, or Generic Name

WHERE TO SEND COMPLETED FORMS:

1. EPCRA Reporting Center
P.O. Box 3348
Merrifield, VA 22116-3348
ATTN: TOXIC CHEMICAL RELEASE INVENTORY

2. APPROPRIATE STATE OFFICE
(See instructions in Appendix F)

Enter "X" here if this is a revision ☐

For EPA use only

IMPORTANT: See instructions to determine when "Not Applicable (NA)" boxes should be checked.

PART I. FACILITY IDENTIFICATION INFORMATION

SECTION 1. REPORTING YEAR

19 ____

SECTION 2. TRADE SECRET INFORMATION

2.1	Are you claiming the toxic chemical identified on page 3 trade secret? ☐ Yes (Answer question 2.2; Attach substantiation forms) ☐ No (Do not answer 2.2; Go to Section 3)
2.2	If yes in 2.1, is this copy: ☐ Sanitized ☐ Unsanitized

SECTION 3. CERTIFICATION (Important: Read and sign after completing all form sections.)

I hereby certify that I have reviewed the attached documents and that, to the best of my knowledge and belief, th submitted information is true and complete and that the amounts and values in this report are accurate based on reasonable estimates using data available to the preparers of this report.

Name and official title of owner/operator or senior management official

Signature

Date Signed

SECTION 4. FACILITY IDENTIFICATION

4.1

Facility or Establishment Name

TRI Facility ID Number

Street Address

City

County

State

Zip Code

Mailing Address (if different from street address)

City

State

Zip Code

PUT LABEL HERE

EPA Form 9350-1 (Rev. 12/4/93) - Previous editions are obsolete.

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EPA FORM R

PART I. FACILITY IDENTIFICATION INFORMATION (CONTINUED)

TRI FACILITY ID NUMBER

Toxic Chemical, Category, or Generic Name

SECTION 4. FACILITY IDENTIFICATION (Continued)

4.2	**This report contains information for: (Important: check only one)**	a. ☐ An entire facility			b. ☐ Part of a facility		
4.3	**Technical Contact**	Name			Telephone Number (include area code)		
4.4	**Public Contact**	Name			Telephone Number (include area code)		
4.5	**SIC Code (4-digit)**	**a.**	**b.**	**c.**	**d.**	**e.**	**f.**
4.6	**Latitude and Longitude**	Latitude			Longitude		
		Degrees	Minutes	Seconds	Degrees	Minutes	Seconds

.7	**Dun & Bradstreet Number(s) (9 digits)**	a. b.
4.8	**EPA Identification Number(s) (RCRA I.D. No.) (12 characters)**	a. b.
4.9	**Facility NPDES Permit Number(s) (9 characters)**	a. b.
4.10	**Underground Injection Well Code (UIC) I.D. Number(s) (12 digits)**	a. b.

SECTION 5. PARENT COMPANY INFORMATION

5.1	Name of Parent Company ☐ **NA**	
.2	Parent Company's Dun & Bradstreet Number ☐ **NA**	**(9 digits)**

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EPA FORM R

PART II. CHEMICAL-SPECIFIC INFORMATION

TRI FACILITY ID NUMBER
Toxic Chemical, Category, or Generic Nam

SECTION 1. TOXIC CHEMICAL IDENTITY	**(Important: DO NOT complete this section if you complete Section 2 below.)**
1.1	CAS Number (Important: Enter only one number exactly as it appears on the Section 313 list. Enter category code if reporting a chemical category.)
1.2	Toxic Chemical or Chemical Category Name (Important: Enter only one name exactly as it appears on the Section 313 list.)
1.3	Generic Chemical Name (Important: Complete **only** if Part I, Section 2.1 is checked "yes." Generic Name must be structurally descriptive.)

SECTION 2. MIXTURE COMPONENT IDENTITY	**(Important: DO NOT complete this section if you complete Section 1 above.)**
2.1	Generic Chemical Name Provided by Supplier (Important: Maximum of 70 characters, including numbers,letters, spaces, and punctuation.)

SECTION 3. ACTIVITIES AND USES OF THE TOXIC CHEMICAL AT THE FACILITY (Important: Check all that apply.)

3.1	**Manufacture the toxic chemical:**	a. ☐ Produce b. ☐ Import	If produce or import: c. ☐ For on-site use/processing d. ☐ For sale/distribution e. ☐ As a byproduct f. ☐ As an impurity
3.2	**Process the toxic chemical:**	a. ☐ As a reactant b. ☐ As a formulation component	c. ☐ As an article component d. ☐ Repackaging
3.3	**Otherwise use the toxic chemical:**	a. ☐ As a chemical processing aid b. ☐ As a manufacturing aid	c. ☐ Ancillary or other use

SECTION 4. MAXIMUM AMOUNT OF THE TOXIC CHEMICAL ON-SITE AT ANY TIME DURING THE CALENDAR YEAR

4.1	☐ (Enter two-digit code from instruction package.)

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PART II. CHEMICAL-SPECIFIC INFORMATION (CONTINUED)

TRI FACILITY ID NUMBER

Toxic Chemical, Category, or Generic Name

SECTION 5. RELEASES OF THE TOXIC CHEMICAL TO THE ENVIRONMENT ON-SITE

			A. Total Release (pounds/ year) (enter range code from instructions or estimate)	B. Basis of Estimate (enter code)	C. % From Stormwater
5.1	Fugitive or non-point air emissions	☐ NA			
5.2	Stack or point air emissions	☐ NA			
5.3	Discharges to receiving streams or water bodies (enter one name per box)				
5.3.1	Stream or Water Body Name				
.3.2	Stream or Water Body Name				
5.3.3	Stream or Water Body Name				
5.4	Underground injections on-site	☐ NA			
5.5	Releases to land on-site				
5.5.1	Landfill	☐ NA			
5.5.2	Land treatment/ application farming	☐ NA			
5.5.3	Surface impoundment	☐ NA			
.5.4	Other disposal	☐ NA			

☐ **Check here only if additional Section 5.3 information is provided on page 5 of this form.**

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Range Codes: A = 1 - 10 pounds; B = 11 - 499 pounds; C = 500 - 999 pounds.

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PART II. CHEMICAL-SPECIFIC INFORMATION (CONTINUED)

TRI FACILITY ID NUMBER

Toxic Chemical, Category, or Generic Na

SECTION 5.3 ADDITIONAL INFORMATION ON RELEASES OF THE TOXIC CHEMICAL TO THE ENVIRONMENT ON-SITE

5.3	Discharges to receiving streams or water bodies (enter one name per box)	A. Total Release (pounds/ year) (enter range code from instructions or estimate)	B. Basis of Estimate (enter code)	C. % From Stormwater
5.3.__	Stream or Water Body Name			
5.3.__	Stream or Water Body Name			
5.3.__	Stream or Water Body Name			

SECTION 6. TRANSFERS OF THE TOXIC CHEMICAL IN WASTES TO OFF-SITE LOCATIONS

6.1 DISCHARGES TO PUBLICLY OWNED TREATMENT WORKS (POTW)

6.1.A Total Quantity Transferred to POTWs and Basis of Estimate

6.1.A.1 Total Transfers (pounds/year) (enter range code or estimate)	6.1.A.2 Basis of Estimate (enter code)

6.1.B POTW Name and Location Information

6.1.B.__ POTW Name		6.1.B.__ POTW Name	
Street Address		Street Address	
City	County	City	County
State	Zip Code	State	Zip Code

If additional pages of Part II, Sections 5.3 and/or 6.1 are attached, indicate the total number pages in this box ☐ and indicate which Part II, Sections 5.3/6.1 page this is, here. ☐

(example: 1, 2, 3, etc.)

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Range Codes: A = 1 - 10 pounds; B = 11 - 499 pou
C = 500 - 999 pounds

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PART II. CHEMICAL-SPECIFIC INFORMATION (CONTINUED)

TRI FACILITY ID NUMBER
Toxic Chemical, Category, or Generic Name

SECTION 6.2 TRANSFERS TO OTHER OFF-SITE LOCATIONS

6.2. __	Off-site EPA Identification Number (RCRA ID No.)		
Off-Site Location Name			
Street Address			
City		County	
State	Zip Code	Is location under control of reporting facility or parent company?	☐ Yes ☐ No

A. Total Transfers (pounds/year) (enter range code or estimate)	B. Basis of Estimate (enter code)	C. Type of Waste Treatment/Disposal/ Recycling/Energy Recovery (enter code)
1.	1.	1. M
2.	2.	2. M
3.	3.	3. M
	4.	4. M

SECTION 6.2 TRANSFERS TO OTHER OFF-SITE LOCATIONS

6.2. __	Off-site EPA Identification Number (RCRA ID No.)		
Off-Site Location Name			
Street Address			
City		County	
State	Zip Code	Is location under control of reporting facility or parent company?	☐ Yes ☐ No

A. Total Transfers (pounds/year) (enter range code or estimate)	B. Basis of Estimate (enter code)	C. Type of Waste Treatment/Disposal/ Recycling/Energy Recovery (enter code)
1.	1.	1. M
2.	2.	2. M
3.	3.	3. M
	4.	4. M

If additional pages of Part II, Section 6.2 are attached, indicate the total number of pages in this box ☐ and indicate which Part II, Section 6.2 page this is, here. ☐ (example: 1, 2, 3, etc.)

Range Codes: A = 1 - 10 pounds; B = 11 - 499 pounds;
C = 500 - 999 pounds.

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PART II. CHEMICAL-SPECIFIC INFORMATION (CONTINUED)

TRI FACILITY ID NUMBER ☐

Toxic Chemical, Category, or Generic Na ☐

SECTION 7A. ON-SITE WASTE TREATMENT METHODS AND EFFICIENCY

☐ **Not Applicable (NA) - Check here if no on-site waste treatment is applied to any waste stream containing the toxic chemical or chemical category.**

a. General Waste Stream (enter code)	b. Waste Treatment Method(s) Sequence [enter 3-character code(s)]	c. Range of Influent Concentration	d. Waste Treatment Efficiency Estimate	e. Based on Operating Data?
7A.1a	7A.1b 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐	7A.1c	7A.1d %	7A.1e Yes ☐ No ☐
7A.2a	7A.2b 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐	7A.2c	7A.2d %	7A.2e Yes ☐ No ☐
7A.3a	7A.3b 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐	7A.3c	7A.3d %	7A.3e Yes ☐ No ☐
7A.4a	7A.4b 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐	7A.4c	7A.4d %	7A.4e Yes ☐ No ☐
7A.5a	7A.5b 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐	7A.5c	7A.5d %	7A.5e Yes ☐ No ☐

If additional copies of page 7 are attached, indicate the total number of pages in this box ☐ and indicate which page 7 this is, here. ☐ (example: 1, 2, 3, etc.)

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PART II. CHEMICAL-SPECIFIC INFORMATION (CONTINUED)

TRI FACILITY ID NUMBER

Toxic Chemical, Category, or Generic Name

SECTION 7B. ON-SITE ENERGY RECOVERY PROCESSES

☐ **Not Applicable (NA) - Check here if no on-site energy recovery is applied to any waste stream containing the toxic chemical or chemical category.**

Energy Recovery Methods [enter 3-character code(s)]

1 ☐ 2 ☐ 3 ☐ 4 ☐

SECTION 7C. ON-SITE RECYCLING PROCESSES

☐ **Not Applicable (NA) - Check here if no on-site recycling is applied to any waste stream containing the toxic chemical or chemical category.**

Recycling Methods [enter 3-character code(s)]

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐

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PART II. CHEMICAL-SPECIFIC INFORMATION (CONTINUED)

TRI FACILITY ID NUMBER

Chemical, Category, or Generic Name

SECTION 8. SOURCE REDUCTION AND RECYCLING ACTIVITIES

All quantity estimates can be reported using up to two significant figures.		Column A 1992 (pounds/year)	Column B 1993 (pounds/year)	Column C 1994 (pounds/year)	Column D 1995 (pounds/year)
8.1	Quantity released *				
8.2	Quantity used for energy recovery on-site				
8.3	Quantity used for energy recovery off-site				
8.4	Quantity recycled on-site				
8.5	Quantity recycled off-site				
8.6	Quantity treated on-site				
8.7	Quantity treated off-site				

8.8	Quantity released to the environment as a result of remedial actions, catastrophic events, or one-time events not associated with production processes (pounds/year)	
8.9	Production ratio or activity index	

8.10 Did your facility engage in any source reduction activities for this chemical during the reporting year? If not, enter "NA" in Section 8.10.1 and answer Section 8.11.

	Source Reduction Activities [enter code(s)]	Methods to Identify Activity (enter codes)		
8.10.1		a.	b.	c.
8.10.2		a.	b.	c.
8.10.3		a.	b.	c.
8.10.4		a.	b.	c.

8.11 Is additional optional information on source reduction, recycling, or pollution control activities included with this report? (Check one box) YES ☐ N ☐

* Report releases pursuant to EPCRA Section 329(8) including "any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment." Do not include any quantity treated on-site or off-site.

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APPENDIX B

APPENDIX B

Toxics Release Inventory (TRI)
Data Element Descriptions

The abbreviation for each data element that appears on the screen each time you search for a field or display a record appears in brackets ([]) following the name of the field. For a list of data elements in alphabetic order by abbreviation, see the Quick Reference Guide.

Accidental Release Total [ACCIDENTAL REL] - Total quantity of toxic chemical released resulting from events (accidental releases) not associated with production processes.

Based on Operating Data [BASED ON OPER DATA] - Indicates whether the waste treatment efficiency estimate is based on actual measurements of the wastestream before and after treatment at the reporting facility. A "no" means some other method was used, such as manufacturers' specifications for the capabilities of the treatment equipment.

Basis of Estimate (Land) [LAND REL/BAS]
Basis of Estimate (Non-Point) [NONPOINT AIR/BASIS]
Basis of Estimate (Offsite) [OFFSITE/BASIS]
Basis of Estimate (Point Air) [POINT AIR/BASIS]
Basis of Estimate (POTW) [POTW/BASIS]
Basis of Estimate (Underground) [UND INJECT/BASIS]
Basis of Estimate (Water) [WATER/BASIS] - The method used to estimate each release. Reporting facilities may use several methods to estimate a release. The facility must report the principal method used or the one used to derive the greatest proportion of the release estimate. The codes are as follows:

M	Based on monitoring data or measurements, including direct measurements of the concentration of the chemical in wastes, discharges, or releases.
C	Based on mass balance equations, which involve, for example, determining the differences between the amount of the chemical in streams entering and leaving process equipment.
E	Based on published chemical emission factors.
O	Based on other approaches such as engineering calculations.

CASRN [CAS NO] - The Chemical Abstracts Service Registry Number (CASRN) consists of up to eight digits (and two hyphens) and uniquely identifies a specific chemical substance. The number is printed in hyphenated format: two to five digits, hyphen, two digits, hyphen, one digit. For example, formaldehyde is 50-00-0; chlorine is 7782-50-5. The CASRN is commonly used to index chemical data and can be useful in locating other information about the chemical. The CASRN may be withheld as a trade secret. A CASRN will not be provided for mixtures or trade name products containing an unidentified section 313 chemical. Chemical categories covered by Section 313 do not have CASRNs because they include many distinct chemical substances.

Centroid Latitude [CENTROID LATITUDE] - Centroid latitude in degrees (3 digits), minutes (2 digits) and seconds (2 digits) is the midpoint latitude of the area defined by the facility zip code. This information was added by EPA to all submissions and is not reported on EPA Form R. Though not as exact as site specific latitude, it is useful for geographic mapping.

Centroid Longitude [CENTROID LONGITUDE] - Centroid longitude in degrees (3 digits), minutes (2 digits) and seconds (2 digits) is the midpoint of the area defined by the facility zip code. This field is provided by EPA and is not reported on EPA Form R. Though not as exact as site specific longitude, it is useful for geographic mapping.

Controlled By [OFFSITE CONTROL BY] - This indicates whether the reporting facility controls the off-site location to which it transfers wastes.

Covered Facility [FACILITY COVERAGE] - A facility could submit a report on releases of the section 313 chemical from the entire facility at the location or on separate establishments within the facility at that location. This data field indicates whether the submission covers the entire facility or only an establishment within the facility. If a submission covers only part of a facility, several submissions may have to be considered to develop complete information on the total releases of the chemical from the entire facility. Two codes were used:

a	An entire covered facility.
b	A part of a covered facility.

EPA ID Number [EPA ID NUMBER] - An identification number assigned by EPA to facilities subject to the Resource Conservation and Recovery Act (RCRA). The number can be used to obtain information from state and federal agencies on the type and amount of hazardous wastes transferred to or from a facility.

EPA Region [EPA REGION] - Identifies in which of the 10 EPA regions the reporting facility is located. EPA regions cover several states and are the local contacts for information about EPA programs.

Region 1	CT, MA, ME, NH, RI, VT
Region 2	NJ, NY, Puerto Rico, Virgin Islands-VI
Region 3	DE, MD, PA, VA, WV, DC
Region 4	AL, FL, GA, KY, MS, NC, SC, TN
Region 5	IL, IN, MI, MN, OH, WI
Region 6	AR, LA, NM, OK, TX
Region 7	IA, KS, MO, NE
Region 8	CO, MT, ND, SD, UT, WY
Region 9	AR, CA, HI, NV, American Samoa-AS, Guam-GU, Trust Territories-MP
Region 10	AK, ID, OR, WA

EPA Submission Number [EPA SUBMISSION NO] - A unique 15 character alphanumeric string assigned by EPA to identify each report received from a facility. The last two characters are the abbreviation of the state of the reporting facility.

Facility City [FACILITY CITY] - City in which the reporting facility is located.

Facility County [FACILITY COUNTY] - County in which the reporting facility is located.

Facility D & B Number [FACILITY D & B] - Facility Dun and Bradstreet Number consisting of nine-digits assigned to identify specific businesses.

Facility Name [FACILITY NAME] - The name of the reporting facility.

Facility State [FACILITY STATE] - State in which the reporting facility is located. Searchable by the two-letter U.S. Postal Service Code.

Facility Street Address [FACILITY ADDRESS] - Street address of the reporting facility.

Facility Zip Code [FACILITY ZIP CODE] - Zip code of the reporting facility. Five- or nine-digit zip codes are acceptable.

Federal Facility [FEDERAL FACILITY]

General Wastestream [GENRL WASTESTREAM] - Each wastestream that enters the environment containing the chemical must be identified separately on Form R. Wastes from several processes may be combined into a single wastestream prior to treatment. If the treatment process creates an additional wastestream, they will be listed separately. For example, treatment of a liquid waste by filtration may create a solid residue that is then treated; the liquid and solid are listed as separate wastestreams on Form R. Wastestream types are identified by the following codes:

A	Gaseous
W	Wastewater
L	Liquid waste other than dissolved in water
S	Solid waste.

Generic Chemical Name [GENERIC CHEM NAME] - Provided only if the reporting facility has claimed the identity of the chemical as a trade secret. The generic name must be descriptive of the chemical structure.

Influent Concentration [INFLUENT CONCENTR] - The influent concentration is the percentage of the waste made up of the chemical as the waste enters the treatment process. This figure includes only the section 313 chemical for which the report was filed. For chemical categories, the concentrations are reported for the parent chemical rather than for the entire compound. Note that EPA requires reporting facilities to list only the concentration of the chemical as it enters the wastestream. If the wastestream is treated sequentially using different treatment methods, the reporting facility may enter the initial influent concentration for each treatment method, or may enter the actual concentration when the method is applied, but is not required to enter either for any treatment method except the first applied to the wastestream. The codes used to identify the range of influent concentration are:

1	Greater than 1 percent
2	100 parts per million (0.01 percent) to 10,000 parts per million (1 percent)
3	1 part per million to 100 parts per million
4	1 part per billion to 1 part per million
5	Less than 1 part per billion.

Land Disposal [LAND DISPOSAL] - Releases to land must be reported by disposal methods. Four codes identify the disposal method used for on-site disposal of reported quantities of the chemical to land:

D02	Landfill
D03	Land treatment/application farming
D05	Surface impoundment
D99	Other disposal.

Land Release [LAND REL] - The reported number of pounds of a chemical released to the environmental medium.

Latitude [LATITUDE] - Latitude of the reporting facility in degrees (3 digits), minutes (2 digits), and seconds (2 digits). Optional in 1987 reports.

Longitude [LONGITUDE] - Longitude of the reporting facility in degrees (3 digits), minutes (2 digits), and seconds (2 digits). Optional in 1987 reports.

Manufacturing [MANUFACTURING USES] - Manufacturing activities involve the manufacture of the section 313 chemical or the importation of the chemical into the United States by the reporting facility. The chemical may be manufactured for use at the reporting facility, for sale, as a byproduct, or as an impurity. Multiple entries are possible:

Produce
Import
For on-site use/processing
For sale/distribution
As a product
As an impurity.

Maximum Amount On-Site [CHEM/MAX ON-SITE] - The maximum amount of the chemical that was on-site at any one time during the reporting year, including the amount present in processing equipment, stockpiles, storage areas, and wastes. The amount is reported in ranges. The codes for the ranges (in pounds) are:

01	0-99
02	100-999
03	1,000-9,999
04	10,000-99,999
05	100,000-999,999
06	1 million-9,999,999
07	10 million-49,999,999
08	50 million-99,999,999
09	100 million-499,999,999
10	500 million-999,999,999
11	1 billion or more.

Mixture Component ID [CHEM MIX COMPONENT] - A trade name, product name or some other generic chemical name that the reporting facility must provide when the facility knows that a section 313 chemical is present in the mixture, but does not know the exact chemical identity of the chemical. This indicates that the facility is processing or using a listed chemical in amounts that exceed the threshold.

Non-Point Air Release [NONPOINT AIR REL] - The reported number of pounds of a chemical released to the environmental medium.

NPDES Permit Number [NPDES PERMIT NO] - The National Pollution Discharge Elimination System Permit Number issued by EPA under the Clean Water Act to cover liquid discharges to surface water. The permit number may be used to access information about the facility's permit requirements and discharges. This information is often available at state environmental regulatory offices and EPA regional offices. The permit may not, however, address the specific chemical being reported under section 313.

Off-Site City [OFFSITE CITY] - The city of the off-site facility to which the reporting facility transfers waste.

Off-Site County [OFFSITE COUNTY] - The county of the off-site facility to which the reporting facility transfers waste.

Off-Site Energy Recovery Current Year [OFFSITE ENERGY/CUR] - Total quantity of toxic chemical in pounds used off-site for energy recovery during the current reporting year.

Off-Site Energy Recovery Future Year [OFFSITE ENERGY/FUT] - Total quantity of toxic chemical in pounds estimated to be used off-site for energy recovery in future year.

Off-Site Energy Recovery Next Year [OFFSITE ENERGY/NEX] - Total quantity of toxic chemical in pounds estimated to be used off-site for energy recovery next year.

Off-Site Energy Recovery Percent Change, Prior/Current Year [OFFSITE ENERGY/PCT] - Percent change in quantity of toxic chemical used off-site for energy recovery comparing current and previous year quantities.

Off-Site Energy Recovery Prior Year [OFFSITE ENERGY/PRI] - Total quantity of toxic chemical in pounds used off-site for energy recovery during previous year.

Off-Site Name [OFFSITE NAME] - The name of the off-site location which receives waste from a reporting facility.

Off-Site Recycling Current Year [OFFSITE RECY/CUR] - Total quantity of toxic chemical in pounds recycled off-site during current year.

Off-Site Recycling Future Year [OFFSITE RECY/FUT] - Total quantity of toxic chemical estimated to be recycled off-site in future year.

Off-Site Recycling Next Year [OFFSITE RECY/NEX] - Total quantity of toxic chemical estimated to be recycled off-site next year.

Off-Site Recycling Percent Change, Prior/Current Year [OFFSITE RECY/PCT] - Percent change in quantity of toxic chemical used off-site for recycling purposes comparing prior and current year quantities.

Off-Site Recycling Prior Year [OFFSITE RECY/PRI] - Total quantity of toxic chemical in pounds recycled off-site during previous year.

Off-Site State [OFFSITE STATE] - The location of the off-site facility to which the reporting facility transfers waste.

Off-Site Street [OFFSITE ADDRESS] - The street address of the off-site location to which the reporting facility transfers waste.

Off-Site Transfer Amount [OFFSITE TRANS AMT] - For each off-site location, the total amount, in pounds, of the toxic chemical contained in the waste transferred to that location for disposal, energy recovery, recycling, or waste treatment.

Off-Site Treatment Current Year [OFFSITE TREAT/CUR] - Total quantity of toxic chemical in pounds treated off-site for current year.

Off-Site Treatment Future Year [OFFSITE TREAT/FUT] - Total quantity of toxic chemical in pounds to be treated off-site in future year.

Off-Site Treatment Next Year [OFFSITE TREAT/NEX] - Total quantity of toxic chemical in pounds to be treated off-site next year.

Off-Site Treatment Percent Change, Prior/Current Year [OFFSITE TREAT/PCT] - Percent change in quantity of toxic chemical treated off-site comparing prior and current year quantities.

Off-Site Treatment Prior Year [OFFSITE TREAT/PRI] - Total quantity of toxic chemical in pounds treated off-site during the previous year.

Off-Site Zip Code [OFFSITE ZIP CODE] - The zip code area of the off-site facility to which the reporting facility transfers waste.

Other Location EPA ID [OFFSITE TRANS ID] - The EPA-assigned identification number of the off-site location if it handles hazardous wastes subject to the Resource Conservation and Recovery Act regulations. The number can be used to obtain other information about the location from Federal and State authorities.

On-Site Energy Recovery Current Year [ONSITE ENERGY/CUR] - Total quantity of toxic chemical in pounds used on-site for energy recovery during current year.

On-Site Energy Recovery Future Year [ONSITE ENERGY/FUT] - Total quantity of toxic chemical in pounds estimated to be used on-site for energy recovery two years following current year reporting.

On-Site Energy Recovery Next Year [ONSITE ENERGY/NEX] - Total quantity of toxic chemical in pounds estimated to be used on-site for energy recovery next year.

On-Site Energy Recovery Percent Change, Prior/Current Year [ONSITE ENERGY/PCT] - Percent change in quantity of toxic chemical used on-site for energy recovery comparing prior and current year quantities.

On-Site Energy Recovery Prior Year [ONSITE ENERGY/PRI] - Total quantity of toxic chemical in pounds used on-site for energy recovery during the previous year for energy recovery.

On-Site Energy Recovery Processes [ONSITE ENERGY/PROC] - On-site energy recovery methods used on the reported chemical. Four codes identify the Energy recovery method used for on-site energy recovery processes. The energy recovery codes are:

U01	Industrial Kiln
U02	Industrial Furnace
U03	Industrial Boiler
U04	Other Energy Recovery Methods

On-Site Recycling Current Year [ONSITE RECY/CUR] -- Total quantity of toxic chemical in pounds recycled on-site during current year.

On-Site Recycling Future Year [ONSITE RECY/FUT] - Total quantity of toxic chemical estimated to be recycled on-site in future year.

On-Site Recycling Next Year - [ONSITE RECY/NEX] - Total quantity of toxic chemical in pounds estimated to be recycled on-site next year.

On-Site Recycling Percent Change, Prior/Current Year [ONSITE RECY/PCT] - Percent change in quantity of toxic chemical used on-site for recycling purposes comparing prior and current year quantities.

On-Site Recycling Previous Year [ONSITE RECY/PRI] - Total quantity of toxic chemical in pounds recycled on-site during previous year.

On-Site Recycling Processes [ONSITE RECY/PROC] - On-site recycling method used on the listed toxic chemical. Fifteen codes identify the recycling methods used for on-site recycling processes. The recycling codes are:

R11	Solvents/Organics Recovery--Batch Still Distillation
R12	Solvents/Organics Recovery--Thin-Film Evaporation
R13	Solvents/Organics Recovery--Fractionation
R14	Solvents/Organics Recovery--Solvent Extraction
R19	Solvents/Organics Recovery--Other
R21	Metals Recovery--Electrolytic
R22	Metals Recovery--Ion Exchange
R23	Metals Recovery--Acid Leaching
R24	Metals Recovery--Reverse Osmosis
R26	Metals Recovery--Solvent Extraction
R27	Metals Recovery--High Temperature
R28	Metals Recovery--Retorting
R29	Metals Recovery--Secondary Smelting
R30	Metals Recovery--Other
R40	Acid Regeneration
R99	Other Reuse or Recovery

On-Site Treatment Current Year [ONSITE TREAT/CUR] - Total quantity of toxic chemical in pounds treated on-site during current year.

On-Site Treatment Future Year [ONSITE TREAT/FUT] - Total quantity of toxic chemical in pounds estimated to be treated on-site in future year.

Onsite Treatment Next Year [ONSITE TREAT/NEX] - Total quantity of toxic chemical in pounds estimated to be treated on-site next year.

Onsite Treatment Percent Change, Prior/Current Year [ONSITE TREAT/PCT] - Percent change in quantity of toxic chemical treated on-site comparing previous and current year quantities.

On-Site Treatment Prior Year [ONSITE TREAT/PRI] - Total quantity of toxic chemical in pounds treated on-site during previous year.

Other Use [OTHER USES] - Other uses and activities of the chemical involve the use of the chemical in such a way that it does not become part of the facility's product. Chemicals may be used to aid processing or manufacturing or may be used in ancillary ways at the facility. Multiple entries are possible:

As a chemical processing aid
As a manufacturing aid
Ancillary or other use.

Parent Company Name [PARENT CO. NAME] - The name of the company that owns the reporting facility.

Parent Duns Number [PARENT CO. D & B] - The Dun and Bradstreet number of the company that owns the reporting facility.

Point-Air Release [POINT AIR REL] - The reported number of pounds of a chemical released to the environmental medium.

POTW - Publicly Owned Treatment Works (also called sewer plants).

POTW City [POTW CITY] - The city of the Publicly Owned Treatment Works (also called sewer plant) facility to which the reporting facility transfers waste.

POTW County [POTW COUNTY] - The county of the POTW facility to which the reporting facility transfers waste.

POTW Name [POTW NAME] - The name of the POTW which receives waste from a reporting facility.

POTW State [POTW STATE] - The location of the POTW to which the reporting facility transfers waste.

POTW Street Address [POTW ADDRESS] - The street address of the POTW to which the reporting facility transfers waste.

POTW Transfer Amount [POTW TRANS AMT] - The reported number of pounds of a chemical transferred off-site of the facility.

POTW Zip Code [POTW ZIP CODE] - The zip code area of the off-site facility to which the reporting facility transfers waste.

Processing [PROCESSING USES] - Processing activities involve the incorporation of the chemical into the product(s) of the reporting facility. The chemical may be processed as a reactant, as a formulation component, or as a component of an article. The chemical may also be repackaged for sale. Multiple entries are possible:

As a reactant
As a formulation component
As an article component
Repackaging only.

Production Ratio or Activity Index [PRODUCTION RATIO] - Ratio of current reporting year production quantities to previous year production.

Public Contact/Phone [PUBL CONTACT/PHONE] - Name and phone number of the person at the reporting facility to contact for further information about the submission or the facility.

Quantity Released Current Year [QUANTITY REL/CUR] - Total quantity of the toxic chemical in pounds released during the current year.

Quantity Released Future Year [QUANTITY REL/FUT] - Total quantity of the toxic chemical in pounds estimated to be released in future year.

Quantity Released Next Year [QUANTITY REL/NEX] - Total quantity of the toxic chemical in pounds estimated to be released next year.

Quantity Released Percent Change, Prior/Current Year [QUANTITY REL/%] - Percentage change in quantity released comparing previous and current year reporting quantities.

Quantity Released Prior Year [QUANTITY REL/PRI] - Total quantity of the toxic chemical in pounds released during prior year.

Range Estimate (Land) [LAND RANGE]
Range Estimate (Non-Point) [NONPOINT AIR/RANGE]
Range Estimate (Off-Site) [OFFSITE RANGE]
Range Estimate (Point-Air) [POINT AIR/RANGE]
Range Estimate (POTW) [POTW RANGE]
Range Estimate (Underground) [UND/RANGE]
Range Estimate (Water) [WATER/RANGE]

A submitter may check a range to report releases of less than 1000 pounds to an environmental medium.
The ranges are:

A. 1-10
B. 11-499
C. 500-999 pounds.

Reporting Year [REPORTING YEAR] - The calendar year for which the FORM R was submitted.

SIC [SIC] - The Standard Industrial Classification code defined.

SIC Code [SIC CODE] - The Standard Industrial Classification (SIC) Code(s) of the reporting facility. The codes indicate the type of activities performed at the facility; several SIC codes may apply to a single facility. Facilities were required to report their four-digit code(s). Complete four-digit codes are listed on Disc One in a file called SIC_Codes. The two-digit codes for general manufacturing areas are:

20	Food and Kindred Products
21	Tobacco Manufacturers
22	Textile Mill Products
23	Apparel and other finished products made from fabrics and other similar materials
24	Lumber and Wood Products (except furniture)
25	Furniture and Fixtures
26	Paper and Allied Products
27	Printing, Publishing, and Allied Industries
28	Chemicals and Allied Products
29	Petroleum Refining and Related Industries (coal)
30	Rubber and Plastic Products

31	Leather and Leather Products
32	Stone, Clay, Glass, and Concrete Products
33	Primary Metal Industries
34	Fabricated Metal Industries (except machinery and transportation equipment)
35	Machinery (except electrical)
36	Electrical and Electronic Machinery, Equipment, and Supplies
37	Transportation Equipment
38	Measuring, Analyzing, and Controlling Instruments; Photographic, medical, and optical goods, watches and clocks
39	Miscellaneous Manufacturing Industries.

Source Reduction Activities [SOURCE REDUCT ACT] - Actions taken by the reporting facility to reduce the amount of a reported toxic chemical.

Source Reduction Activities:
- Good Operating Practices
- Inventory Control
- Spill and Leak Prevention
- Raw Material Modifications
- Process Modifications
- Cleaning and Degreasing
- Surface Preparation and Finishing
- Product Modifications

Source Reduction Methods [SOURCE REDUCT METH] - Method(s) or information sources used to identify the possibility for a source reduction activity. Eleven codes identify the source reduction methods for source reduction activities. The source reduction methods codes are:

T01	Internal pollution prevention opportunity audit(s)
T02	External pollution prevention opportunity audit(s)
T03	Materials balance audits
T04	Participative team management
T05	Employee recommendation (independent of a formal company program)
T06	Employee recommendation (under a formal company program)
T07	State government technical assistance program
T08	Federal government technical assistance program
T09	Trade association/industry technical assistance program
T10	Vendor assistance
T11	Other

State/County FIPS Code [FIPS CODE] - The five-digit FIPS (Federal Information Processing Standards) code can be used to identify the state and county of the reporting facility. EPA added the code to each submission.

Stormwater Percent [PERCENT STORMWATER] - For releases to water, some percentage of the release may come from rainwater runoff from building roofs, storage piles, or other areas. The percentage of the release due to stormwater runoff must be estimated if the facility has monitoring data on the chemical.

Stream Name [STREAM NAME] - The name of the receiving stream(s) to which the facility releases listed chemicals. Estimates on Form R are specific to the receiving stream. If a reporting facility releases the chemical to more than one receiving stream, the releases to all streams must be added to determine total releases to water. Note that the reporting facility may list receiving streams to which it does not release the chemical covered by the submission.

Substance Name [CHEM NAME] - The name of the section 313 chemical.

Sum Air Releases [SUM AIR REL] - Summation of non-point and point chemical releases in pounds.

Sum All Releases to Environment [SUM ALL RELEASES] - Summation of all chemical releases to the environment in pounds.

Sum Land Releases [SUM LAND REL] - Summation of all chemical releases to land in pounds.

Sum Off-Site Transfers [SUM OFFSITE TRANS]- The reported number of pounds of a chemical transferred off-site of the facility.

Sum POTW and Off-Site Transfers [SUM POTW/OTH TRANS] - Summation of all POTW and off-site transfers in pounds.

Sum POTW Transfers [SUM POTW TRANS] - Summation of all releases in pounds to publicly owned treatment works.

Sum Releases and Transfers [SUM REL/TRANS] - Summation of all environmental releases and transfers to publicly owned treatment works in pounds.

Sum Underground Releases [SUM UND INJECT REL] - Summation of all chemical releases injected underground in pounds.

Sum Water Releases [SUM WATER REL] - Summation of all chemical releases to water in pounds.

Treatment Efficiency [TREAT EFFICIENCY] - This provides an estimate of the percentage of the chemical physically removed, destroyed, or converted by the treatment methods. Treatment efficiencies for chemical compounds are reported for the chemical. Most treatment methods are more effective at higher influent concentrations so influent concentrations should be considered when comparing treatment efficiencies. For wastestreams treated sequentially by several treatment methods, reporting facilities may submit the treatment efficiency for all methods taken together. The reporting facility is not required to list treatment efficiency for any but the final step, but may list the aggregate efficiency for all steps in the sequence. For example, if the aggregate efficiency is 75 percent, the facility may list the 75 percent with the last step of the sequence or may enter 75 percent with each step.

Treatment Method [TREAT METH/SEQ] - The method of treatment used on the wastestream to reduce the amount of the chemical being released. The codes fall into the following general categories:

A01-A07	Air Emissions Treatment
B11-B99	Biological Treatment
C01-C99	Chemical Treatment
F01-F99	Incineration/Thermal Treatment
P01-P99	Physical Treatment
R01-R99	Recovery/Reuse
G01-G99	Solidification/Stabilization.

TRI Facility ID [TRI FACILITY ID] - A facility identification number generated by EPA using facility name, address and zip code: Format: zzzzznnnnnsssss where zzzzz = zip code, nnnnn = first five consonants of the name, sssss = first five non-blank, non-special characters in the street address.

Type Treatment, Disposal [OFFSITE DISP METH] - This includes the type of treatment or disposal associated with the chemical at the off-site location. The codes are:

Disposal:

M10	Storage only--Indicates any means of storage
M71	Underground Injection
M72	Landfill/Disposal Surface Impoundment
M73	Land Treatment--Destruction of chemical by spreading on land
M79	Other Land Disposal
M94	Transfer to Waste Broker--Disposal

Recycling:

M20	Solvents/Organics Recovery
M24	Metals Recovery
M26	Other Reuse or Recovery
M28	Acid Regeneration
M93	Transfer to Waste Broker--Recycling

Waste Treatment:

M40	Solidification/Stabilization
M50	Incineration/Thermal Treatment
M54	Incineration/Insignificant Fuel Value
M61	Wastewater Treatment (Excluding POTW)
M69	Other Waste Treatment
M95	Transfer to Waste Broker--Waste Treatment

Energy Recovery:

M56	Energy Recovery
M92	Transfer to Waste Broker-Energy Recovery

UIC ID [UND INJ ID] - The Underground Injection well Code identification number assigned by EPA under the Safe Drinking Water Act to facilities that dispose of wastes in certain types of permitted underground injection wells. The number may be used to obtain information from State regulatory agencies on the reporting facility's waste disposal to underground wells.

Underground Release [UND INJECT REL] - The reported number of pounds of a chemical released to the environmental medium.

Water Release [WATER REL] - The reported number of pounds of a chemical released to the environmental medium.

APPENDIX C

QUICK START INSTRUCTIONS FOR
UNDERSTANDING TRI

BACKGROUND: Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA) of 1986 required EPA to establish an inventory of toxic chemical emissions from manufacturing facilities. The purpose of this reporting requirement is to inform the public and government officials about routine and accidental releases of toxic chemicals to the environment. EPCRA established that the public has a "right-to-know" environmental information reported to EPA under the statute. The Toxics Release Inventory (TRI) has been used extensively for research, by neighborhood coalitions and public interest groups seeking reductions in toxic releases, and as the basis for industry participation in voluntary pollution prevention efforts. EPA also uses the data base to assist in development of environmental programs and rulemaking.

REPORTING REQUIREMENTS: Facilities subject to TRI reporting are required to submit an EPA Form R every July 1st for each chemical they released into the environment (e.g., air, water, etc.) or transferred offsite for treatment or disposal during the preceding calendar year. The reporting requirement applies to owners and operators of facilities that have 10 or more full-time employees; belong to Standard Industrial Classification (SIC) codes 20 through 39 (i.e., manufacturing facilities); and manufacture (including importing), process or otherwise use a toxic chemical in excess of specified thresholds. Over 300 chemicals were designated as toxic for the years covered by these CD-ROMs (1987-1993). New chemicals can be designated as toxic through rulemaking and petitions, and in fact, 286 additional chemicals have been added, effective in reporting year 1995.

IMPACT OF TRI: The inception of a national toxics inventory has resulted in greater public and industry awareness of the extent and effects of chemical pollution. Since implementation of TRI, total annual chemical releases by U.S. manufacturing facilities have declined considerably. Many companies have instituted measures to prevent chemical pollution, such as substituting safer chemicals or reengineering processes. In 1990, Congress passed the Pollution Prevention Act (PPA), resulting in expansion of TRI. Beginning in 1991, companies were required to report additional data about pollution prevention activities and projected future releases. TRI is continuing to develop: EPA is studying options for extending coverage to additional industries. In 1994, Clinton signed an Executive Order requiring Federal facilities to submit TRI reports.

This search guide is intended to supplement the CD-ROM User Manual and the Brief User Guide accompanying the CD-ROM. For help or more information contact: TRI User Support, (202) 260-1531

INSTALLATION OF CD-ROM SOFTWARE: The 1987-1993 CD-ROM set contains new, menu-driven installation software that allows you to choose from several optional features when it is loaded. For your convenience, installation software is provided on both discs; either disc (but not both) may be used to load the software. Follow instructions for installing CD-ROM as outlined in manual and in the Quick Reference Guide that accompanied the disc.

DATA BASE STRUCTURE: The 1987-1993 TRI CD-ROM set, comprised of two discs, supersedes all earlier editions of the CD-ROM. Disc One contains TRI for the years 1987-1990; Disc Two contains the 1991-1993 TRI. Data on each disc is divided into two files:

The TRI **RELEASES** file, the larger and more frequently-used file, contains comprehensive facility identification information. The RELEASES file provides the total amounts of the chemical released to air, water, land, publicly owned treatment works (POTW) and transferred to offsite locations. It also describes how the chemical is used, the maximum amount onsite during the year, and pollution prevention efforts such as source reduction and recycling. **Use when:** Looking for general information about facilities (i.e. location, Dun & Bradstreet #s), chemicals (i.e. maximum amount on site or use of chemical), or industries (SIC codes and trends). Also search by releases to specific bodies of water (i.e., Lake Superior) or POTWs or commercial offsite locations where wastes are transported (i.e., ABC Waste Co. or names and addresses of offsite locations in Pittsburgh, PA).

The TRI **TREATMENT** file contains data on waste treatment methods and efficiency, and waste minimization. **Use when:** Looking for information on waste treatment.

CHEMICAL SUBSTANCE FACT SHEETS: Each disc contains a complete set of fact sheets for each chemical listed on TRI. They describe, in layman's terms, ecological and health effects resulting from release and exposure; identifying and treating symptoms, and OSHA exposure limits and other standards pertaining to the chemical. **Use when:** After searching TRI to identify the chemicals released in a specific locality or other criteria.

PERFORMING CALCULATIONS (KASTAT): This feature allows you to sum, average, and perform other calculations using a dBase file exported from TRI. There are a number of fields representing different types of releases. The system allows you to page through screen displays showing calculations performed on each amount field contained in the dBase file.

README FILES: The CD-ROM contains five files that provide documentation for the database and other information:

README.NOW contains vital information about the contents of this disc set.

FIELDS.TRI contains descriptions of all the data fields including codes and translation of coded information.

REGIONS.EPA contains the names, addresses and phone numbers of the 10 Federal EPA regional contacts.

SIC_CODE contains the four-digit Standard Industrial Classification codes for 20-39 and the code descriptions.

STATES contains the names, addresses and phone numbers of the State and Territorial TRI contacts.

Additionally, the text of the manual is provided in the README directory.

QUICK START INSTRUCTIONS FOR SEARCHING TRI

Insert Disc Two. Use the main menu to choose TRI Data Base from the Data Base Selection Menu and <enter>. Highlight the Releases data base and press <enter> twice.

SAMPLE SEARCH (Releases File)

EXAMPLE: Find all releases in New Jersey for 1991-1993.

1. Press **F3=SELECT**
2. Use arrow keys to go to **Facility State <enter>**
3. Enter search term **NJ <enter>**

Set	**# Found**	
1	**8210**	**FACILITY STATE: NJ**

TO OBTAIN ALL TRI DATA FOR ONE RECORD: When searching by data elements common to both the RELEASES file and the TREATMNT file (for example, by facility name or location or chemical), search each file separately, then sort records into the same order. Each file should contain the same number of records. Or, retrieve multiple sets of data and match records in each file by EPA Submission Number which uniquely identifies each record. (Linking files requires use of dBase or other software not on the CD-ROM.)

TO NARROW A SEARCH BY COMBINING SEARCH STATEMENTS WITH "AND"

There are two methods for combining search statements to narrow a search:

1. Combine sets with "AND" (example 1).
2. Change Search Set to limit searching to records within a previously created search set (example 2).

The most efficient method depends on the size the search set retrieved. If the sets are not too large, use boolean searching shown in example 1. Otherwise, if one search yields thousands of records, follow example 2. By Changing Search Set, you are limiting your search to records meeting the first criteria, instead of searching the entire data base. If you Change Search Set, you _must_ change it back to 0 (zero) to resume searching the entire data base.

EXAMPLE 1: Retrieve all releases for NJ for 1993.

1. Search for NJ as the Facility State. Press F3, highlight Facility State, press <enter>, type NJ, press <enter>. 8,210 records retrieved.

2. Search for 1993 as the Reporting Year. Press F3, highlight Reporting Year, press <enter>, highlight 1993, press <enter>. 79,984 records retrieved. (Notice that searching the entire data base by Reporting Year is slow.)
3. Press F5=SETS. Highlight Combine Sets, press <enter>. Highlight Combine with AND, press <enter>. Type 1, <enter>, AND 2, <enter> AND <enter>. Name your set (optional). 2,575 records retrieved.

EXAMPLE 2: Retrieve all releases for NJ for 1993.

1. Search for NJ as the Facility State. Press F3, highlight Facility State, press <enter>, type NJ, press <enter>. 8,210 records retrieved.
2. Press F5=SETS. Highlight Change Search Sets, press <enter>. Type 1 for set to search in, press <enter>. (Note Search Set Number at bottom of screen now = 1.)
3. Search for 1993 as the Reporting Year. Press F3, highlight Reporting Year, press <enter>, highlight 1993, press <enter>. System searches only the 8,210 records from step 1. 2,575 records retrieved.

TO EXPAND A SEARCH BY COMBINING SEARCH STATEMENTS WITH "OR" AND USING THE INDEX

Follow the directions for NARROWING A SEARCH (Example 1) but choose to Combine Sets with OR. Plan to search as many synonyms for a term as possible by using the database's index. All searchable fields are indexed.

EXAMPLE: Search for all General Motors Company facilities.

General Motors can be found under GM or GMC or General Motors or General Motors Company. **Hint:** Search both the facility name and parent company name fields. If you enter General Motors, you will get a search equivilent to General <AND> Motors. There are no adjacency operators for searching this data base. False drops may occur. If you are unsure of terms or spelling, use truncation (?) to browse the index for available terms.

1. Press **F3=SELECT**
2. Use arrow keys to go to **Facility Name <enter>**
3. Enter search term with the question mark (?) to look at the index and choose the best term(s).**GM? <enter>**
4. Go to correct word(s) and use the grouping keys (F7, F8 and F9) to mark the term(s) you want searched. Go to first occurrence of GM, mark it with the F7(↓) key. Use the arrow key to move down to last occurrence and mark it with the F8(↑) key. To select a single name, use the F9(✓)key.

SCREEN

```
          F4=SEARCH                                  F4=SEARCH
        FACILITY NAME (PHRASE)                     FACILITY NAME (PHRASE)
         ↓GM                                        √ GM
         ↑GMC                       OR              √ GMC
          GMP                                         GMP
          GMPT                                        GMPT
```

5. When all terms are marked, press **<enter>** to search.
6. Repeat steps with General or Motor? or other synonyms.
7. Combine sets created by using "OR".

QUICK START INSTRUCTIONS FOR
DISPLAYING AND SORTING TRI DATA

DISPLAY A SET

You can display the current output set by pressing F6=DISPLAY. You can display any set by pressing **F5=SETS** and choosing **Display a Set**. It is easy to re-rank data, change output fields, and print the record being viewed. When viewing any record, press <enter> and the Action Menu will appear. Choose New Display Form to specify selected fields and limit the display to fields meaningful to your inquiry. Sort records by designating multiple fields using the ranking feature. When you use **F5=SETS**, you are given the option of ranking the data and choosing the output fields before viewing the data.

SORT FEATURE

You may sort a set when displaying it to screen, printing it, or exporting it (F5). The default order for search results is by EPA Submission Number, unique to each record. To provide a more logical, useful arrangement, there are several choices for sorting your set. You can also display by User Defined Rank which allows you omIf the way you want to sort it is not shown, you can pick Display by User Defined Rank. You can use this feature to sort on more than one field.

EXAMPLE: I have a set of all releases in Maryland. I want the data arranged alphabetically by facility name and each chemical arranged alphabetically under each facility.
e.g. ABC Co. - acetone
ABC Co. - toluene
DDD Co. - freon 113

1. Press **F5=SETS** and choose **Display a Set**.
2. Choose **Display by User Defined Rank**.
3. Use arrow keys to go to **Facility Name <enter>**
4. Type **1 <enter>** (This is the first field you want sorted by)
5. Use arrow keys to go to **Chem Name <enter>**
6. Type **2 <enter>** (This is the second field you want sorted by)
7. Use arrows to return to top of list to **End Rank Selections <enter>** to start sort.

NOTE: Sorting on more than 3 criteria will take the computer a long time to perform. If you want to sort release amounts in descending order, type a minus sign before the number. Example: Sort by Sum Air Release with highest releases first. Use arrow keys to go to Sum Air Release<enter>, and type -1 **<enter>**.

QUICK START INSTRUCTIONS FOR
EXPORTING FROM TRI

You may export a set in **comma delimited (ASCII), fixed field, DBASE, Lotus, WP [Word Perfect] Merge, or print to disk format.**

EXAMPLE: Export set #4 which contains releases in MD in 1993.

1. Press **F5=Sets.**
2. Use arrow keys to choose **Export a Set**, press <enter>.
3. Type set number 4, press <enter>.
4. Use arrow keys to highlight desired format, press <enter>.
5. Choose sort criteria. (See **SORTING TRI** for directions.)
6. Choose from among 3 output options:
   Releases or Treatmnt - includes all fields, including blanks.
   Releases (Brief) or Treatmnt (Brief) - includes only fields containing data. (Not recommended for exporting.)
   User Selected Output - allows you to choose fields to be included. Use the grouping keys (F7, F8, and F9) to mark the desired fields. **HINT**: Choose only those fields that you need. **You must use the form designer if you are downloading fields with repeating fields.**

7. Type name of file (and path if different than that shown) **MD93 <enter>.**

QUICK START INSTRUCTIONS FOR
PRINTING TRI DATA

To print a RECORD:
You may print a single record while you are viewing the record on your screen. Press **<enter>** to get the **ACTION MENU**. Use arrow to choose **PRINT CURRENT RECORD <enter>**.

To print a SET:
This can be done at any time. You are led through the choices you must make by menus found under F5=SETS.

EXAMPLE: Print search set #4.

1. Press **F5=SETS.**
2. Use arrows to choose **PRINT A SET <enter>.**
3. Type # of set: **4 <enter>**
4. Choose sort criteria. (See SORTING TRI DATA for directions.)
5. Choose output criteria:
   Releases - Contains all datat elements, including blanks.
   Releases (Brief) - Includes only fields containing data. (This format does not work when planning to import data into Lotus, dBase, etc., because each record is a different length, depending on which fields are blank.)
   User Selected Output - Gives you a list of all fields which can be printed. Use the grouping keys (F7, F8, and F9) to mark the fields which you want printed.
6. Use arrows to choose **Consecutive Print** or **Page at a Time**.
7. Align paper and press **<enter>** when ready.

QUICK START INSTRUCTIONS FOR CALCULATING TRI RELEASES

The KASTAT feature is used to compute the total amounts for a set of data. **You must use the RELEASES file to retrieve the data.**

EXAMPLE: Want to know the total amount of toluene released in Maryland in 1993.

1. Follow search and combine instructions to retrieve a set for records which have MD only as the facility state, 1993 as the Reporting year, and toluene as the substance name.
2. Follow the export instructions.

Choose set #. Choose DBASE. Choose default order. Choose user selected output.

Mark these 8 fields ONLY

Field 1-Sum Air Rel
Field 2-Sum Water Rel
Field 3-Sum Land Rel
Field 4-Sum All Releases
Field 5-Sum POTW Trans
Field 6-Sum Offsite Trans
Field 7-Sum POTW/Oth Trans
Field 8-Sum Rel/Trans

Name file--type **MD93TOL<enter>**

3. Exit to main menu **(F10)**.
4. Choose **4 Calculate Releases** (KASTAT) by using arrow keys to highlight it on the menu <enter>.
5. Type file name: **MD93TOL<enter>**
6. There is one screen for each field that is computed. Use the right and left arrow keys to go from one to another. To print all records, press p then right arrow to change records until all eight screens are printed.

EXPLANATION OF KASTAT FIELDS

1. **Field number** refers to which field the calculation was performed on. **Field number: 1 is Sum Air Release.**
2. **Number of records** refers to the number of records in the set of data on which the calculations are being performed. **The Number of Records in the set of data was 89.**
3. **Number of Blanks** refers to the number of records which had a blank or no data in that field. **No records had Blanks in the Sum Air Release field, therefore all records had releases of Toluene to the Air.**
4. **The Lowest single release of Toluene to the air was 2 pounds. The Highest single release of Toluene to the air was 1,874,820 pounds.**
5. The **Range** is the difference between the Highest and the Lowest single release. **In this instance Highest minus Lowest (1,874,820 - 2 = 1,874,818).**
6. *****The Sum** is the total sum of the field on which the calculation is being processed (in this case the Sum Air Release field.) **Therefore the total release of Toluene in MD in 1993 to the air was 6,434,741 lbs.**
*****The SUM data is the most useful.**
7. The **MEAN WITH and W/O 0** is the average of the field on which the calculation is being processed. **Therefore the average release of Toluene in MD for 1993 by each facility was 73,122.05 lbs.**
8. **Press the right arrow to view the next field, Sum Water Rel. Repeat for each of the numeric fields chosen.**

QUICK START INSTRUCTIONS FOR

DESIGNING FORMS FOR PRINTING AND EXPORTING TRI DATA

THE CD COMES WITH TWO FORMS ALREADY AVAILABLE FOR EACH FILE (RELEASES AND TREATMENT). THESE FORMS, FULL RECORD AND BRIEF RECORD, CAN BE USED IMMEDIATELY FOR EXPORT OR PRINTING.

Use the form designer when you want to download fields that may be repeated in a record. The form designer "saves a space" for fields that are blank. For example, a facility may have up to six Standard Industrial Classification Codes (SIC codes), but most have less than three. If you were to download a set of records in an ASCII, DBASE or Lotus format by using the User Selected Output to choose the fields, each record would be different be a different length, depending on the number of SIC codes in each. As a result, the downloaded file would be unusable by most software.

The form designer allows the user to choose specific fields, including repeating fields like SIC, and download them in a usable format. If you are downloading fields with multiple occurrences (but not the full record), it is highly recommended that you create a form for downloading. The Form Designer is menu-driven and relatively easy to use. In order to use the Form Designer, save your set list (F5) and exit to DOS.

At the DOS prompt, follow the instructions in the manual or Quick Reference Guide precisely. You will be creating your own form which then appears with the other output choices. You can create as many forms as you like. When you are through, return to the CD-ROM, load your set list (F5) or repeat the search. This time, when you are ready to export or print the data, the name of the form that you just created will be listed along with the other choices for output formats.

The data exported by using the Form Designer and Comma Delimited are both comma and quote delimited. **NOTE: All fields are treated as character fields by the Form Designer.** If you are converting data into another format such as Paradox, you must create your file structure by specifying all fields as "character" fields. After conversion, it is a simple matter to change the field specification from "character" to "numeric" for fields which may be used for calculations.

When you use the Form Designer, consider how you would want the data displayed in a report. For example:
For a created set of records, you want the first SIC code first and then the first SIC description, the second sic code second and then the second sic description, etc.

2951
Asphalt paving mixtures and blocks
2952
Asphalt felts and coatings

To do this you must choose sic/array 1, sic code/array 1, sic/array 2, sic code/array 2.

NOTE: Follow the manual or Quick Reference Guide precisely. WHEN "MISSING DATA RULE" IS HIGHLIGHTED, YOU MUST TYPE L OR SELECT THE "L LABEL..." OPTION.

APPENDIX D

APPENDIX D

Sources for Further Assistance

Toxics Release Inventory User Support (TRI US)

EPA, TRI US (TS-793)
401 M ST, SW
Washington, DC 20460

Telephone Number: (202) 260-1531

Hours: 8:00 a.m. - 4:30 p.m. (Eastern Time) Monday - Friday

TRI US can assist you with general information about TRI or refer you to another TRI contact (private, public, or government). TRI US can provide search assistance in TRI and provide NLM/TOXNET on-line search training. Your comments are very important and have helped to improve each subsequent CD-ROM product.

The Emergency Planning and Community Right-to-Know (EPCRA) Hotline

Telephone Number: 1 (800) 535-0202

Hours: 8:30 a.m. - 7:30 p.m. (Eastern Time) Monday - Friday

The EPCRA Hotline provides general information and assistance about TRI and related programs and the distribution of TRI publications.

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ISBN 0-16-048124-4
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Getting Started

A Guide to Bringing Environmental Education Into Your Classroom

---

"Once the curriculum was developed and I began working with the kids, their obvious enthusiasm for environmental topics was energizing. Never... had I seen students get so involved and committed in their efforts."

Jerry Christy
Math, Science and Technology Curriculum Coordinator

"So many materials became available from so many different sources that I had no trouble creating a one-week, multi-disciplinary environmental unit."

Vicki Rich
Third Grade Teacher

"The other math teachers are delighted that I can help reinforce these concepts. The kids usually don't know why a percentage or ratio is helpful, they just memorize the formula. By talking about eagles or buffalo, these math concepts have a context and finally become relevant."

Lynn Kelly
Seventh Grade Teacher

"I was amazed at the positive reactions I got from the students. This is classwork they can enjoy because they can relate to it."

David Chapman
Twelfth Grade Teacher

The Environmental Education
Toolbox

Getting Started

A Guide to Bringing Environmental Education Into Your Classroom

Edited by
David Bones

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EPA

This project has been funded by the United States Environmental Protection Agency under assistance agreement number N 901935-01-0 to the University of Michigan, School of Natural Resources and Environment and by the United States Department of Energy, the Tennessee Valley Authority, and the United States Environmental Protection Agency under assistance agreement number X8179928-01-8 to the National Environmental Education and Training Foundation.

ISBN 1-884782-00-0

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The printing is donated by Amway Corporation, Ada, Michigan. The material for this publication consists of 25% recycled Amway office waste.

Design and Layout
Department of Marketing Communications
University of Michigan

We would like to acknowledge the contribution of, and give credit to, the following people for photographs used in "Getting Started:" Steve Delaney of the U.S. Environmental Protection Agency; Kay Dodge of the Center for Environmental Studies in Grand Rapids, Michigan; Dennis Travis of the Bloomfield Hills Public Schools; Martha Monroe and Kim Wade of NCEET. All photographs used in "Getting Started" were produced from slides contained in NCEET's "Slide Resource Kit," designed for teacher educators to use in EE workshops.

The EE Toolbox supports environmental inservice education. Toolbox resources are designed to help inservice educators broaden their environmental education programs for teachers.

The Toolbox

- — Workshop Resource Manual– provides background for trainers and workshop activity outlines. The manual will cover topics including:
  - Defining EE
  - Designing Workshops
  - Integration of EE
  - Reaching New Audiences
  - Approaches to Issues
  - Using Local, Remote and Computer Resources
  - Evaluation
  - Developing Administrative Support
- — Classroom activity collection.
- — Collection of reference articles on EE and education.
- — Slide Resource Kit for use in EE workshops with classroom teachers. A prepared slide show and audio narration provides an introduction/overview of EE. Additional slides on special topics can be used to create a variety of other slide presentations.
- — Getting Started – a collection of teacher success stories and a guide to EE for classroom teachers.
- — Success Story Primer – an exploration of the use of stories in EE curriculum.
- — Computer disk of Toolbox handouts and overhead masters.

NCEET works to support, enhance and extend effective environmental education in grades K-12. In addition to the EE Toolbox, NCEET activities include:

- — working with a variety of resource management and education organizations to develop inservice training programs and workshops using the EE Toolbox.
- — making the materials and the messages of environmental education more accessible to teachers and students. NCEET has an on-line computer service (EELink) that will provide a single point of access to environmental educational resources on the Internet.
- — expanding the audience for environmental education. In 1994, NCEET will publish articles and columns in trade literature and the popular press and host a series of roundtable and working meetings. Collaborations with corporate partners will provide the opportunity to reach mass audiences through television programs and additional computer networks.
- — supporting partners in "small experiments," exploratory efforts with important implications for educators.
  Examples include:
  - — Urban EE with Howard University
  - — Remote sensing and EE with Aspen Global Change Institute
  - — Environmental Education in Native American communities with the Sonoran Arthropod Studies, Inc.

The Environmental Education
EE
Toolbox

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Acknowledgments

The National Consortium for Environmental Education and Training and the National Environmental Education and Training Foundation would like to thank the many individuals and organizations that contributed to "Getting Started." It is impossible to list all those involved, however those listed below deserve special recognition.

We are grateful to the following people for their contributions: Brad Smith, Michael Baker, George Walker and Kathleen MacKinnon of the Environmental Education Division at the U.S. Environmental Protection Agency; Richard Wiles of the Environmental Exchange in Washington, D.C.; Alan Sandler of the American Architectural Foundation in Washington, D.C.; Terry Smith of the National Geographic Society Education Foundation in Washington, D.C.; Deborah Redmond of the Environmental Education Associates, Inc. in Washington, D.C.; Andrea Shotkin of the North American Association for Environmental Education; Dennis Yockers of the Wisconsin Department of Public Instruction; and U.S. Environmental Protection Agency Regional Environmental Education Coordinators: Maria Pirie, Teresa Ippolito, Bonnie Smith, Rich Nawyn, Suzanne Saric, Sandy Sevier, Rowena Micheals, Cece Forget, Ida Toliver, and Sally Hanft.

Finally, many thanks to the teachers who so willingly shared their time, experience, and stories. We hope that their enthusiasm for environmental education and willingness to share their experience inspires readers to begin their own initiatives.

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Introduction

What is "Getting Started?"

"Getting Started" is primarily a collection of stories about everyday teachers who initiated not-so-everyday environmental programs in their classrooms and schools.

The teachers profiled are special, dedicated individuals, but they are in no way unique or exclusive. They represent hundreds of teachers nationwide who teach in high schools, middle schools and elementary schools; public schools and private schools. They are teachers in urban, suburban and rural areas; science teachers, math teachers and language arts teachers; history teachers, art teachers and teachers of home economics.

Some of the teachers profiled in "Getting Started" have been nationally recognized. But the majority are everyday teachers whose successes are only locally known. Many were surprised when they received our telephone call asking for their story. "Why do you want *my* story?" was a common reply. Surprised or not, the teachers included in "Getting Started" enthusiastically explained the details of their efforts in interviews that, in many cases, lasted over an hour. All were eager to share their story with others who are just "Getting Started."

The process of creating the story usually involved subsequent calls to fill in details. In many cases, contextual details were also added to increase the readability of the story. To insure accuracy of the resulting story, however, a draft was sent to the teacher for comments, and the story was edited accordingly.

Throughout the book are brief sections covering educational materials and resources, funding, environmental education workshops and inservice opportunities, and the locations of other educators interested in environmental education. These lists are not comprehensive; but are designed to help teachers find resources to meet their unique needs.

Why this Guide?

"Getting Started" was originally envisioned by the National Environmental Education and Training Foundation as a directory to various models and methods of environmental education in kindergarten through twelfth-grade classrooms. It became apparent through collaboration with NCEET, however, that many such "directories" already exist. It also became clear that it is not a lack of interest or materials that prevents teachers from initiating environmental education (EE) efforts in their classrooms. Instead, it is the usual constraints: limited financial resources, little time for additional lesson plans, lack of knowledge about how to integrate EE materials into existing lessons, and so on. Therefore, it appeared that what would be most useful to teachers interested in initiating EE efforts in their classrooms would be a glimpse of the many useful resources that exist, and some examples of teachers who have been able to overcome the usual constraints.

It was obvious that the effort should be organized around stories of real teachers. Why stories? Interesting stories can contribute to one's recall, comprehension and ability to apply concepts from one setting to another by providing imagery from other people's experiences. The stories are intended to highlight the creativity of educators who have infused EE into numerous subject areas to the delight of students, parents, and school administrations. It is hoped that these glimpses into classrooms across the country will inspire other teachers to add environmental concepts to their lessons, to design units that lead their students in the study of local environmental issues, to attend environmental education workshops, and to network with other environmental educators.

An underlying theme throughout this guide is the belief that environmental education promotes not only an environmentally literate public, but is also an effective means of raising the quality of the total educational experience. As the stories illustrate, environmental education increases student participation and achievement in all areas of learning by promoting the study of issues that really interest them.

How to Use "Getting Started"

"Getting Started" is intended as a road map of suggestions and ideas for teachers who are interested in bringing environmental education into their classroom. Like a road map, "Getting Started" does not tell its users how fast they need to go, by which route or even where they should end up. Instead, it is intended to provide teachers with ideas of what to pack, what to expect on their journey, where to go for help, and how to share the sights and surprises of their journey with others along the way.

"Getting Started" is divided into three units. The first provides a brief overview of the scope, history, and value of environmental education. The second offers suggestions for instructional materials, funding, workshops, courses, and in-service opportunities in environmental education. The third unit includes information on networking with other environmental educators, securing grants for your EE program, dealing with a growing EE project, and locating awards, scholarships and stipends that are available for environmental educators and their students.

Each unit contains:

(1) General information about how to bring EE into your classroom. Teachers are used as examples in these sections, with the title of the story that features them in quotation marks following the teacher's name.

(2) A list of sample sources to consult for more information. Longer lists of organizations and resources are included in the resource indices.

(3) A collection of stories to provide imagery of how other teachers incorporated environmental education into their classrooms.

An index of stories provides readers with information about each story. The index identifies areas of EE content covered in the story, such as water quality, toxics, energy consumption, and so on. The index also identifies areas of EE process, such as developing student awareness, motivating student action-taking, and so on.

The appendices include a list of select resource materials, suggestions for resources to include in your library, and a feedback form.

	Teacher Name	Story Title	Page	Grade	EE Content						EE Process						
					Water Quality	Air Quality	Solid Waste/Recycling	Wildlife Habitat/Endangered Species	Toxics	Energy Consumption	Using an Interdisciplinary Curriculum	Creating A Student-Centered Program	Developing Student Awareness	Increasing Student Knowledge	Encouraging Student Attitude Development	Building Student Skills	Motivating Student Action-Taking
Unit 1	**Batastini**	***Caribbean Dream***	**19**	**High**	x	x		x	x		●		●	●	●	●	
	Challa	*Themes for a Lesson Plan*	22	Elem				x			●		●	●		●	
	Chapman	***Stories Connect Past and Future***	**24**	**High**	x				x		●		●	●		●	
	Hamn	*The Most Appealing Peanut*	26	Elem			x						●	●	●		●
	Warren	***From Kentucky to Russia... With EE!***	**28**	**High**	x				x		●	●	●	●	●	●	●
	Tucker	*Am I Teaching Them Enough?*	30	High	x		x		x			●	●	●	●	●	●
	Kelly, Lynn	***Eagle Project Takes Wing***	**32**	**Mid**				x			●			●	●	●	
	Ferriss	*Too Much Stuff*	34	Mid			x		x		●	●	●	●	●	●	●
	Mitchell	***Nature Trail Into the Mainstream***	**36**	**Mid**				x			●	●		●		●	
	Leigh	*Okra's O.K.*	38	Elem							●		●	●	●	●	
	Zuckerman	***Action for the Forest***	**40**	**High**				x			●	●	●	●	●	●	●
Unit 2	Dahlquist	*"Z" is for Zero Waste*	62	Elem			x	x					●	●	●		
	Scheer	***Learning on the Job***	**64**	**Mid**	x						●	●	●	●	●	●	●
	Fowler	*Adapting Assignments*	66	Mid	x			x			●			●		●	
	Hauser	***Who's Park is This?***	**68**	**Elem**			x						●	●			
	Holsten	*Spilled Oil Spreads Science*	70	Mid	x					x	●	●	●	●	●	●	●
	Williams	***A Picture Tells a Thousand Stories***	**71**	**Elem**				x			●		●	●			
	Trusler	*The Energy Patrol Strikes*	73	Elem						x	●	●	●	●	●	●	●
	Terminello	***The Greening of Dania***	**74**	**Elem**							●		●	●	●	●	●
	Kelly, Jerri	*Mangrove Monitor Madness*	75	Mid				x			●		●	●	●		
	Marsh	***Big Sky Country Expeditions***	**76**	**Mid**	x	x	x	x	x	x	●		●	●	●		
	Kenna	*Empowering Emily*	78	Mid							●		●	●	●	●	●
	Rich	***Things That Aren't Supposed to Be There***	**80**	**Elem**			x				●		●	●	●		
Unit 3	Pine	*We Never Give Up!*	92	Elem		x				x	●	●	●	●	●	●	●
	Alexander	***The Big Stink***	**94**	**High**	x								●	●	●	●	
	Grove	*Handling Hurdles*	95	High	x					x			●	●			
	Cochran/Whitney	***A Rainforest Takes Over the School***	**97**	**Mid**				x			●		●	●		●	●
	Novak	*One Fish, Two Fish, Red Fish, School Fish!*	99	High	x				x				●	●		●	
	Mullinnix	***The Sky's the Limit***	**100**	**Mid**							●		●	●	●	●	
	Smith	*Have You Seen My Slender Salamander?*	102	High				x			●	●	●	●	●	●	●
	Turner	***Big Brothers, Big Sisters***	**103**	**High**	x								●	●	●	●	
	Hines	*Recycling Snowballs*	105	Elem			x				●		●	●	●	●	●
	Jenore	***Where Do Carrots Come From?***	**106**	**Elem**							●		●	●	●	●	
	Christy	*An Interested and Energetic Force*	107	Elem	x		x	x			●						
	Pennock	***Partners in Philanthropy***	**109**	**Elem**							●	●				●	●

We Welcome Your Feedback

Above all else, we hope that this guidebook provides educators with useful information, in a manner that is enjoyable to read. We encourage and would greatly appreciate your comments on both the organization and contents of this book. In addition, if you know of a successful profile, or are yourself using environmental education in innovative ways, please contact NCEET. We can most effectively address your feedback if you put your comments and concerns in writing. A postage-paid reply form is included at the end of this guide for your convenience.

Unit 1
The Beginning

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The Beginning

Am I an Environmental Educator?

In Leslie Dahlquist's classroom *("'Z' is For 'Zero Waste'")* "A" isn't for "Apple," it's for "Aluminum." She uses "Aluminum" to begin the week's discussion of recycling. Each week for the remainder of the school year, Leslie, a kindergarten and first-grade teacher in Topanga, California, uses a letter from the "Environmental A-B-C's," a book that she and her students created three years ago, to guide each week's lesson planning. Tim Fowler, *("Adapting Assignments")*, a sixth-grade teacher in Baltimore, supplements environmental topics from his science text with assignments that include studying the effects of human impacts such as nutrient loading, shipping channels, and overfishing on the nearby Chesapeake Bay. Aline Novak *("One Fish, Two Fish, Red Fish, School Fish")* is a high school biology teacher in western Maryland. Her students study the effects of a herbicide used for local crops on local waterways by conducting experiments with trout they raise in 55-gallon drums in her classroom.

Most likely, neither Leslie, Tim nor Aline think of themselves as "environmental educators." In fact, it is unlikely that many of the teachers featured in this guidebook consider themselves to be "environmental educators." And yet they— like countless other teachers across the country— are incorporating environmental themes into their lessons. In doing so, they are increasing their students' awareness of the environment, leading students to adopt environmentally conscious attitudes and behaviors, and teaching students the knowledge and skills to make environmentally responsible choices. That certainly makes these teachers environmental educators. If you, like the teachers featured in "Getting Started," are bringing environmental issues into your classroom, you too are an environmental educator.

What is "Environmental Education?"

Environmental education is more than teaching about the environment. It is about people. Environmental education stresses the exploration of attitudes and values, and the development of knowledge and skills, so that people can take an active part in decision-making in the world around them.

Environmental education is not a subject-specific content area. Rather, it is an educational process made up of five elements: Awareness, Knowledge, Attitude, Skills and Participation.

Awareness

Environmental education seeks to build awareness– both a sensory awareness of the world around us, as well as an awareness of societal issues and problem-solving strategies. To Lydia Hamn *("The Most Appealing Peanut")*, a fourth-grade teacher whose students learn about overpackaging through an activity that puts them in charge of creating the "most appealing peanut," environmental education is "helping students become aware that there are choices they can make as consumers, and that there are many implications to the choices they make."

Knowledge

Increased awareness encourages students to improve their knowledge and understanding of natural processes as well as social, political and economic processes. This is important to David Chapman *("Stories Connect Past and Future")*, a high school teacher who relates stories of environmental problems in Michigan to similar incidents around the globe to illustrate "the interconnectedness of the world."

Attitudes

Students' attitudes may change or mature as they develop a deeper appreciation of and respect for the natural world and for individual people and cultures. Mary Jo Terminello's third-grade students (*"We Never Give Up"*) formed a "baggie brigade" to collect soil from home to grow plants in their classroom. Once they saw their actions made a difference, they felt a greater responsibility to the environment and began to pursue other environmental endeavors. They raised money and gathered enough materials to plant more than 600 plants and 60 trees and shrubs at the school.

Skills

The development of process skills involves teaching students how to think, not what to think. This enables them to become more effective decision-makers. Decision-making skills include: critical thinking and communication skills, analytical and observational skills, negotiation and conflict resolution skills, and the ability to identify and clarify values. To David Tucker *("Am I Teaching Them Enough?")*, whose students conduct "garbage chemistry," an analysis of soil samples from a local landfill, environmental education is a way to teach students analytic skills, and to have students investigate real issues that personally affect them.

Participation

Ultimately, the goal of environmental education is to encourage students to apply their knowledge, skills and commitment outside the classroom— for students to participate in decisions. Participation can mean changing personal behavior, or involving oneself in decisions affecting the school, neighborhood or community. To Bonnie Trusler, whose fifth-grade students studied their school's energy consumption *("The Energy Patrol Strikes")*, environmental education is a way of "helping kids know they can make a difference." And her students had a real impact. They actually designed and implemented a program that reduced their school's electricity consumption by about 25 percent, saving their school thousands of dollars.

Is Environmental Education New?

Both the term "environmental education," and the strategies associated with it, emerged in the 1950's and gained momentum with events in the 1960's and 70's. Events such as the publication of Rachel Carson's book *Silent Spring* in 1962, the first view of the whole Earth broadcast from space in 1969, and the first Earth Day in 1970 increased awareness of human impact on the natural environment. Growing concern over fuel shortages, soil erosion, population growth, air and water pollution, and the problems of the urban environment created a demand for a special kind of education— one that examined human behavior, and political and economic decision-making as well as biophysical science.

Several earlier educational movements greatly influenced environmental education. Nature Education encouraged learning by first-hand observation and direct experience, both in the classroom and outdoors. While it began in the late 1800's and remained popular until the 1920's, Nature Education has had a lasting influence on early childhood and elementary science education.

Conservation Education began in the early 1900's. Today, conservation educators and resource specialists educate the public about the importance of wise-use, scientific management and conservation practices to prevent further degradation of natural resources. The Progressive Education movement stressed "learning by doing," and steered curriculum reforms toward a more holistic approach to learning. Outdoor Education evolved more recently. It is primarily an educational approach or method, as opposed to a subject area. It encourages the use of the outdoors as an alternative educational setting to the classroom.

Other movements have also influenced environmental education. The Civil Rights movement made a contribution to environmental education by inspiring individuals with a belief in the power of the individual to shape society. In turn, this movement led to the growth of environmental organizations, the creation of the Environmental Protection Agency and the passage of the Clean Water Act of 1972.

Environmental education is distinct from previous educational strategies. It stresses the combination of values exploration, knowledge and skill development, and a commitment to action. By including both the natural and human-built environment, and by encouraging people to develop both a sense of wonder and a sense of responsibility for their environment, environmental education addresses the heart of environmental problems and solutions—that is, human behavior.

Why Environmental Education?

Why do Leslie Dahlquist, Aline Novak, Tim Fowler, Lydia Hamn, David Tucker, Mary Jo Terminello and countless other educators teach about the environment?

On one level the answer seems obvious. As we learn more and more about the impact of humans on the life-sustaining systems of Earth, it is critical that we re-examine our relationship to our environment through environmental education. Quality environmental education will lead to the acquisition of knowledge, the development of analytical skills, the beginning of environmentally conscious attitudes, and, ultimately, to environmentally responsible behavior.

Today's students are tomorrow's leaders and decision-makers. They need to learn and practice the skills necessary to protect, preserve, and restore the environment. There is a real need to educate people about issues such as air and water quality, the sustainability of our natural resources, loss of species diversity, and waste management so that they can make intelligent, responsible choices in the future. Simply put, environmental education may be a matter of survival.

But why teach environmental education *at school*? Or why, for example, in social studies, math or English class? How is environmental education relevant to urban students? Can environmental education be taught by teachers without a science background? Won't environmental education crowd out a curriculum that is already bursting at the seams?

Environmental education is an excellent means for interdisciplinary study. The skills and knowledge students learn are readily transferable to other disciplines. Lynn Kelly's science students *("Eagle Project Takes Wing")*, use math skills to analyze data from nearby Glacier National Park eagle populations. "The other math teachers are delighted that I can help reinforce math concepts. The kids usually don't know why a ratio or percentage is helpful, they just memorize the formula. By talking about eagles or buffalo, these math concepts have a context and finally become relevant."

Environmental education is appropriate for any audience. Gary Smith *("Have You Seen My Slender Salamander?")*, is a biology teacher in a high school where students of color make up a majority of the population. He believes that involving minority students in the environment means "you have to tie the human environment to the natural environment through environmental education activities that involve collaboration, negotiation, agreement and problem-solving." His students learn that homelessness and poverty are just as much environmental issues as the endangered species they study.

You don't have to have a science background to teach environmental education in your classroom. John Scheer *("Learning on the Job")*, a teacher certified in social studies and language arts, designed and now teaches an environmental issues course. He sometimes "simply learns right along with his students" as he delves into environmental themes to help focus the course on student interests. David Marsh *("Big Sky Country Expeditions")*, invites representatives from the Fish and Game Commission, the Soil Conservation Service, and the U.S. Forest Service to speak to his class about local environmental issues.

Environmental education can be integrated into existing curricula. To Mary Batastini *("Caribbean Dream")*, a teacher who developed an integrated curriculum for ninth graders at her school, environmental education has meant increased student enthusiasm for school. "The ninth grade has the best attendance record in the school. We're getting rave reviews from parents, too."

Environmental education is exciting. It is an excellent way to engage student interest and motivate student learning.

Do I Have to Go It Alone?

Although it may be up to you to take the first steps in bringing environmental education into your classroom, you will likely find support from a variety of sectors. Your colleagues, your school administration and your community are all potential allies.

Communicating with other teachers about your ideas will likely generate additional ideas and you may find enthusiastic supporters who wish to help with your efforts. Perhaps you can, as Rosalie Cochran did, enlist other teachers in your EE initiative. Her rainforest unit *("A Rainforest Takes Over the School")* has grown over the course of five years to include participation by nearly every teacher in the school.

Sharon Ferriss *("Too Much Stuff")*, describes her EE efforts as "very much a team effort, including teachers, administrators and students." Discussing your ideas with your principal, superintendent and perhaps even the school board, and encouraging their support, may open more doors. Mary Batastini *("Caribbean Dream")* sold her principal on her Earth-WISE curriculum by presenting him with a well-thought out idea. The principal gave her permission to pilot the project. The program involves the entire ninth grade and is getting rave reviews from students and parents alike. Jerry Christy *("An Interested and Energetic Force")* reports that environmental education has coalesced the school community into one "interested and energetic force."

Your community can have a tremendous impact on your EE program, and your program can benefit the community. Teachers often find that pooling the energies of these two sectors results in an amazingly dynamic environmental education program. When Mary Jo Terminello *("The Greening of Dania")* needed soil to begin her project to "green" her school grounds, she turned to parents for support—and got it. Denise Leigh *("Okra's O.K.")* and Debra Mullinnix *("The Sky's the Limit")* encouraged families from the community to participate in their schools' gardens. One of Bonnie Trusler's students *("The Energy Patrol Strikes")* ventured into the community to implement the class's energy reduction program at the local post office.

You might find that your community views environmental education as a "scare tactic," "propaganda," or as a threat to local livelihoods. David Marsh *("Big Sky Country Expedition")* faced a similar dilemma. But he was able to teach EE in a non-threatening way in this community, where most jobs are in agriculture, talc mining or logging. "The kids get into lively discussion since their families are involved in one aspect of the environment or another." Although controversy is at times unavoidable, David sees it as an important part of the learning process.

Often, gaining community support simply involves open communication with those who oppose the idea. Even the strongest opposition may be convinced to support your environmental education program when they have a clear understanding of your ideas and motives.

In most cases, your initial show of determination, enthusiasm, and commitment for environmental education is all it will take to get support for your initiative. If there is opposition to your idea, ask for a trial run. Once your program begins, it will be hard for anyone to deny its merit.

Caribbean Dream

The sun smiled brightly on the tiny, Caribbean Island of Providenciales that April day last year. This was not at all like the horrible weather Mary had left behind in Rhode Island. Scarcely a week before, Mary had done her "last minute travel to someplace warm" thing again with the travel agent. Now here she was, settled down for a long weekend of relaxation in a scuba diver's paradise.

Level
- High School

Story Focus
- Enlisting Administrative Support
- Enlisting Community Support
- Locating Instructional Resources

Her daughter was down the beach, entrusted for the day to the care of a suntanned scuba instructor. "Scuba diving?" Mary thought. "Not for me!" Mary was all set to do what she liked best on vacation: stretch out on the beach, surrounded by her books, with plenty of time to think. Mary pondered her job teaching ninth-grade English at a vocational school. Thoughts scuttled across her mind like the clouds that had dominated the April sky back home...

"Nobody seems to like teaching ninth grade."

"How can we make ninth grade more enjoyable for teachers and students? How can we make it more effective for the students?"

"How can we fit the program to the kids, instead of fitting the kids to the program?"

"School is such an artificial environment. How can we expose kids to new developments in the real world?"

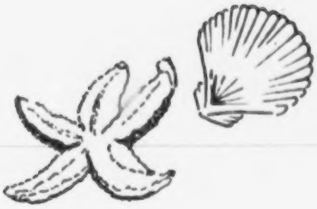
"I've always been opposed to ability groupings. One kid may be a reader, and the next may not be, but they all have experiences to share."

"How can we deal effectively with large classes?"

"After 13 years of teaching at this school, why do I still feel there's more we could be doing?"

These thoughts tumbled through her mind, while the sand sifted between her toes each time she dug them in and lifted her foot back out. As Mary gazed out over the lapping waves, an idea kept surfacing. During the remainder of her vacation, Mary organized her thoughts around the idea: A new way to make ninth grade more enjoyable for both students and teachers, exposing students to cutting-edge developments in the real world. Despite the Rhode Island weather awaiting her, Mary was excited to return to school to discuss this concept with her principal.

Mary Batastini
Wm. M. Davies, Jr. Career
and Technical High School
Jenckes Hill Rd.
Lincoln, Rhode Island 02865



Back at school, Mary was both confident and excited in her presentation. "I'd like to offer an integrated curriculum to the entire ninth grade, one that's built around study of the environment. Team teaching. No ability groupings. Mosaic scheduling. Monthly field trips to see how what they're learning applies to the real world. The works!" said Mary. "Earth WISE: Wholly Integrated Studies of the Environment," she continued. The principal was impressed, and Mary got the go-ahead to pick her team of teachers for the core curricular areas: science, social studies, language arts and math.

At Davies Technical School, students spend the first two periods of each day in vocational areas. Ninth-graders, who haven't yet picked a major shop area, rotate through a new one every four weeks. At Mary's suggestion, in addition to the teacher's introduction to the shop area, students are now exposed to environmental information as well. Mary explains: "I met with each of the shop teachers for the ninth grade and asked them if they could include material that ties in the shop area with relevant aspects of conservation and pollution prevention. For example, in auto body shop, the kids learn to recognize the toxic chemicals in the shop, how they are dangerous to people and the environment, and why safe disposal is so important."

Meanwhile, during those first two hours of the day, Mary's team makes their plans. "We started the school year with a blueprint, but no set curriculum. We were really flying by the seats of our pants. We generated a list of skills that a student needs by the end of ninth grade, to make sure that kids get all the basics. We developed a blueprint consisting of quarterly themes: Ecosystems, Land, Water, Air. Each theme is broken into smaller units within the quarter. Generally, we like to start with the big picture, and then focus locally."

The first unit, on the Universe, went something like this: Science classes learned about theories on the origin of the universe, then they focused on some of NASA's recent discoveries about the chemistry of the planets. Social Studies classes picked up the theme, learning to place the 'pieces of the solar system' in their respective positions around the sun, and recognizing their sizes and orbits. The same idea was applied to the 'pieces of the world,' as students were introduced to global geography. Meanwhile, in math classes, students learned about scale, comparing the immense distances of space with more modest ones on earth. And Mary's English students read a number of creation myths, and capped the unit by writing their own myths.

This winter, Mary didn't go back to the Caribbean. Instead, her students transported her to the shore, through the desert, and along scenic river valleys. She explains: "We've developed integrative unit tests. A team of four students is assigned a project in the morning, which is due in the afternoon of the same day. In each class, they work on a different part of the project, putting the pieces together. For this unit, each team had to construct a diorama of an assigned ecosystem. We collected cardboard boxes for them to assemble their projects in, a large stack of old National Geographic magazines they could clip from, and an odd assortment of rocks, soil and twigs from the woods. The scenes had to be realistic and factually correct. All elements in the scene had to be to scale, and the expected variety of life forms had to be represented. Pie graphs on the outside of the box illustrated the relative percentages of each life form in that ecosystem. And attached to the top, like miniature billboards, each student on the team had to write a bit of free verse about their ecosystem diorama."

"We're getting **rave reviews from parents,** too. They say, 'Whatever you're doing, it's working.'"

Mary says "the kids love" the pilot Earth WISE. "The ninth grade has the best attendance record in the school this year, and the kids have noticed that there are fewer fights among them. Even the school nurse says she rarely sees ninth-graders any more. We're getting rave reviews from parents, too. They say, 'Whatever you're doing, it's working. Believe it or not, my kid can't wait to get to school.'"

Mary attributes the program's success to the integrated, team approach. "All the teachers on the team are there because they believe in the idea. Their dedication is clear from the enormous amount of time and effort we've put into making this thing work, and we've been left to develop it ourselves, without administrative involvement. It works for the students because the topics are connected and relate to the real world. Just as important, the ninth-graders all know one another because of the way we've scheduled our classes. And, of course, they have to work together." ■

Themes for a Lesson Plan

The cardboard tree looms over half of the first-grade classroom. It's bare when the children arrive in the fall, but by spring it is rich with leaves, animals in its bark and holes, and seeds for future growth. Inside and outside the classroom, the children have incorporated trees into reading, science, fine arts, language arts, math, social science and geography lessons. Teacher Mary Anne Challa uses thematic planning in her lesson plans, with the focus on trees.

Level

- Lower Elementary

Story Focus

- Locating Instructional Resources
- Locating Funding: Fundraising
- Locating Funding: Grantwriting

"I think of the Earth as belonging to them," Mary Anne explains. As a parent to her five children, the local Blanford Environmental Education Program encouraged her to get involved. Mary Anne became active and inspired to teach. After having been a mother, a gardener and water-color artist, Mary Anne took up teaching at age 50. From her experience with the Blanford EE Program, she saw how inspirational and integral an environmental education component was to learning and decided to focus her class thematic plan on the environment. In particular she chose trees for the focus, a tremendously popular choice with her first-grade class.

Mary Anne Challa
Stocking Elementary School
863 Seventh Street, N.W.
Grand Rapids, Michigan 49504

The first-graders see a bare tree the first day in class, in the corner of the room, adjacent to a book shelf crammed with books about trees. Over the course of the year, children bring in leaves collected at home or on the way to-and-from school. The children study the leaves under small microscopes. They sort, classify and press all the leaves. They outline the shapes of maple and oak leaves, they feel the sap from the fir trees, they compare chestnuts to acorns to pine cones. Once the leaves are identified, some are attached to the tree while others are used as models to make new leaves out of colored contact paper, plastic and cardboard.

Outside, each child adopts a tree. The child names the tree, identifies the tree, studies the bark, conducts a bark rubbing, notes the leaf shape, the nut, seed or cone, the height and width of the canopy, and takes a string measurement to compare with a second one in the spring to measure growth. The children take responsibility for identifying and noting the changes of the tree during the school year.

As the seasons change, so does the classroom's tree. The children note and mimic the changes in their adopted outdoor trees on the classroom tree. The cardboard squirrels on the tree get fatter as they prepare for winter, as does the stash of acorns in their hole. The insects lay eggs, and then, as winter approaches, they disappear. A cross-section illustrates the fluids that move up and down the tree. As the tree "awakens" in the spring, the children see the water that was stored in the roots for the winter begin to work its way up to the buds, producing blossoms and seeds.

In the spring, a slowly emerging tropical rainforest begins to occupy the other half of the classroom. Layer by layer the children construct the rainforest. As each layer is built, a close study and comparison to Michigan forests and trees is made. There are hundreds of animals, birds, insects and trees to identify and label. New vocabulary words and places to find on the world map excite the children. Most of the children come from single-parent homes, in a lower-income area, and have never left the state.

Brazil, Venezuela, Columbia, and Belize are located and marked on the map. Words such as habitat, xylem and phloem send the children racing to the dictionary. The children compose letters to other first-graders in Costa Rica and await responses. Next year, hopes are to extend this effort by putting together a book on Michigan trees with illustrations and explanations, exchanging it with a book of Costa Rican trees put together by their Costa Rican counterparts.

Stocking Elementary in Grand Rapids tends to be enthusiastic about thematic planning, but funding is tight. Mary Anne takes creative steps when acquiring materials for the classroom. Not only does she apply for small service learning grants through the Kellogg Foundation and the PTA, but she frequently makes trips to local paper mills to scavenge recycled materials, such as paper, cardboard, Styrofoam, plastic and tissue. ■

"The **children take responsibility** for identifying and noting the changes of the tree during the school year."

Stories Connect Past and Future

David Chapman modestly says that he doesn't "feel like an all-star teacher," but in his own small way he has given students in Haslett, Michigan, an awareness of environmental issues, many of which affect them personally. David teaches ninth-grade physical science, as well as occasional earth science classes. Currently, he is also teaching an elective course entitled "Environmental Issues" to 11th- and 12th-graders.

Level
- High School

Story Focus
- Locating Instructional Resources

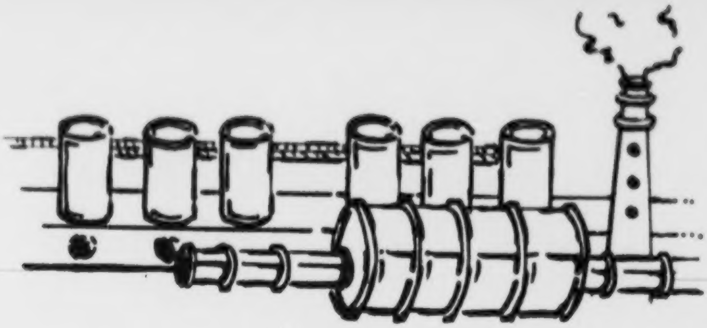
In his classroom after the day's classwork is finished, David appears comfortable. "Even though I've been involved with many school and community environmental projects, and I helped found the school's environmental club, I understand how overwhelming it can be when a teacher is faced with the prospect of teaching about these issues. They are always very complicated and can sometimes bring out a lot of emotions."

He gets out of his chair and ambles over to the large plate glass window at the back of the room. "I know I felt uncomfortable when I started this Environmental Issues class. You just have to take it one step at a time. I was amazed at the positive reactions I got from the students. This is classwork that they can enjoy because they can relate to it."

David Chapman
Okemos High School
4000 Okemos Road
Okemos, Michigan 48864

David is very interested in the way environmental stories affect students. He is currently practicing his story-telling skills as he relates important historical case studies to students. "I couldn't believe that they had never heard of the PBB disaster that occurred throughout Michigan in the early 70's. Fire retardant accidentally mixed into cattle feed caused animals to drop dead all over the state. At the same time, the chemical contaminated the animal's milk, milk that was being sold all over the state. This was something that was directly relevant to the students' lives, and they didn't know about it. When I told the story, they were angry and frustrated. It is important to relay to them the injustices, but also the fact that individuals can succeed with a lot of persistence and understanding of the situation.

"I also try to show them the role of governmental regulation and monitoring, that it is necessary even if it is inadequate. Ideally, these students will take away specific attitudes towards government and environmental issues so they can and will act on problems in the future."



The sources for David's information on these case studies are easily accessible. When preparing a story, he first chooses a subject which is relevant to the students' lives, or one through which he can introduce related information, such as the food chain and toxicology. He then looks up any discussions of the original situation in books and newspaper articles. "With the PBB incident, I began with one book by Rich and Sandra Halber, and went from there. It's refreshing to find out how many other sources one can get from one book."

Other case studies that David has used include Three-Mile Island and the story of Rachel Carson. "Through these stories, I can really show the interconnectedness of the world, tying events in Michigan to similar incidents around the globe, such as the Minimata Disease Disaster in Japan." In 1956, the Minimata Health Department reported that "an unclarified disease of the central nervous system had broken out." Investigators noticed that cats and other animals that ate fish from the bay would stagger around as though drunk, salivating and suffering from convulsions, before dying. These animals helped lead investigators to the cause of the 'disease;' an industrial discharge of heavy metals into the bay.

"I was amazed at the **postive reactions** I got from the students. This is classwork that they can enjoy because **they can relate** to it."

"It is always valuable to show these students that these are not isolated incidents," says David. "When I tell my stories my students become extremely attentive, and can get very emotional. I've had a few who have even cried. That's what I would call 'getting a student's attention!' I often cite the quote 'Those that ignore the past are bound to repeat it' to my students, and I believe that with all my heart. I am just trying to give these kids the knowledge and the tools with which to face a world where environmental disasters are becoming an ever-present reality." ■

The Most Appealing Peanut

While her fourth-grade students get organized, Lydia Hamn walks up and down the rows giving everyone one peanut. A low murmur fills the room and Lydia smiles. "Hey, what is this for?" blurts out a student, holding his peanut above his mouth ready to drop it in.

Level

- Upper Elementary

Story Focus

- Enlisting Administrative Support
- Enlisting Community Support
- Locating Instructional Resources

"Each one of you is in the department of advertising for a peanut company, and it's your job to sell this peanut," Lydia announces. "You can use any technique you'd like: You can give your peanut a name, you can write poetry about it, you can even use gimmicks that you've seen on TV. I also happen to have a box over here filled with material with which you can package your peanut." Lydia opens a box filled with gift paper, little boxes, sequins, foil and many other decorations. She gives the students the rest of the hour to package their product. A shuffle of chairs and bodies fills the room as students move about excitedly gathering their supplies.

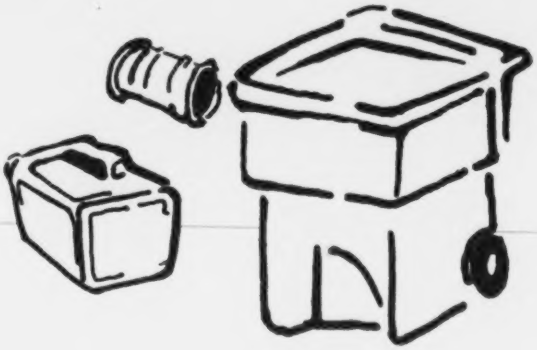
Lydia Hamn
Waterloo School
Hudson, Iowa 50643

By the end of the hour, a neat display of packaged peanuts lines the windowsills. Each package has a number and Lydia explains that the next day when the students come back, she'll have them be consumers and go out and order their favorite peanut. When the bell rings to end class, the students leave the room talking excitedly among themselves about their efforts to create the most appealing peanut.

"They can buy anyone's peanut but their own," Lydia says in the empty room. "Inevitably, the majority of the students pick the fancier, more elaborate packaging jobs," she chuckles, pointing to the biggest package, wrapped in brightly colored cellophane with sequins. "The real discussion starts when I ask them what it was that they really wanted. Just the peanut," she emphasizes. "But, you got all this extra stuff and what are you going to do with that, I ask them. From there we roll into a discussion about packaging and what companies do to entice people to buy their products.

"The idea here isn't to point any fingers at particular companies," continues Lydia, "but to help students become aware that there are choices they can make in terms of being a consumer, and there are many implications to the choices they make.

"One little girl told me she made a big sacrifice by giving up her favorite pizza, one that was fully packaged with a colorful cover. She chose another brand with less packaging and now she says she likes it just as much. Another little boy, who was having a birthday party announced to his friends that they shouldn't buy him anything with a great amount of packaging and that they should just bring it in a paper bag. Many of my students also come to school bringing forks and spoons from home, instead of using the plastic ones in the lunch room.



"This is only the beginning of our consumer behavior unit," explains Lydia. "From there, we get into material on landfills and what's biodegradable. We even do a little experiment where we bury typical trash items for three months. After three months, we dig it out and typically find that hardly anything has degraded, not even the newspaper. This leads to a discussion about the process by which materials are broken down.

"We also spend a couple weeks weighing our trash at home to see if it fits with the national average. I have the students notice what goes into their garbage and then think of ways in which their garbage could be minimized. Many of them spend several days designing ways in which they can reuse products.

"The idea here isn't to point any fingers at particular companies, but to help students become aware that **there are choices** they can make in terms of being a consumer **and there are many implications** to the choices they make."

"It's really exciting to see their enthusiasm," Lydia says. "When I first started doing some of these activities, our former principal was not very supportive. He felt it was more important to stick with the curriculum mandates, but I was so excited about the subject area that I went ahead and did some activities anyway. With our new principal, I have a lot more support and I'm hoping I can expand my program and try many more things.

"Although the parents tease me about the little adjustments they've made in their buying habits, I can tell they're supportive," Lydia says. "They share stories about how their grandmother has always reused things. And they realize that it's really saving them money." ■

From Kentucky to Russia...With EE!

Level
– High School

Story Focus
– Locating Instructional Resources

Student feedback from Andrea Warren's sophomore biology classes at Franklin Simpson High School has been overwhelmingly positive. Students talk not of "making the easy A's" but instead of "learning lots and loving it." Franklin is a small high school, of about 800 students in rural Kentucky. Andrea's biology course is an extensive hands-on investigation into environmental and bioethical issues, both local and distant. The course is separated into several different projects, all bringing the students into the decision-making process by incorporating their ideas into the development of each project. One project looks at the water quality of nearby Drake Creek. "It's a comparative study," Andrea explains, "taking samples of the water above and below the city and comparing them to studies of previous years. The students report their results to the state of Kentucky and the local town government.

Andrea Warren
Franklin Simpson High School
Bowling Green, Kentucky 42104

"We also have a sixteen-acre wetland site which the students have used to design an outdoor classroom for use by all schools in the district," continues Andrea. "They study micro-succession and perform comparative studies which help them understand the 'real' world. We're definitely at an advantage as a rural school, compared to those schools in Louisville or Cincinnati. We have a variety of readily accessible areas where the kids can get their hands dirty and get involved."

Another project involves case studies on the effects of chemicals on the environment. The students pore over studies on the ozone layer, acid rain, the use of DDT and other pesticides, come up with proposed solutions to the conflicts, then compare their solutions with what has actually been done. They write letters to congressional representatives to voice their opinions on relevant issues.

Andrea has a long history of involvement in environmental education. Most recently, she worked with the Environmental Quality Commission in designing teacher education packets. "I feel a need to be a part of the teacher-teacher relationship as well as the student-teacher relationship," she says. "It's very important, to work with both educators and teenagers in getting raw data from the community and teaching how to ask 'what does this mean,' 'what comes next,' and 'what can we do?'"

Andrea's leadership in environmental education won her the opportunity to travel to Rostov, Russia with other teachers. Now when her students learn about Kentucky's environmental quality issues they compare them with issues in other parts of the world. Cultural differences, political concerns, history, and language awareness supplement the science in cross-cultural environmental issues. The relationship involves the trade of information via letters and telecommunication.

"This is the only way to solve the environmental crisis in which we find ourselves," Andrea says. "We need to be willing to use some of these incredible communication networks to work together to share information, solve conflicts, address issues, and educate our youth." ■

"It's very important, to work with both educators and teenagers in getting raw data from the community and teaching how to ask **'what does this mean'**, **'what comes next'**, and **'what can we do?'**"

Am I Teaching Them Enough?

Level

- High School

Story Focus

- Enlisting Community Support
- Locating Instructional Resources
- Networking With Other Educators

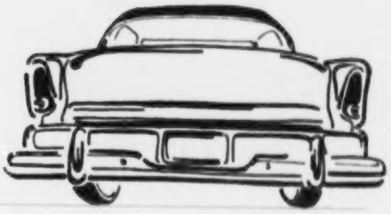
"Compared with Mr. Tucker's chemistry class at Mt. Baker High School, Deming, Washington, science classes at college have been boring," said Kenneth, who is visiting home during his spring break. "At the university, it's mostly reading books and doing experiments in the lab. In Mr. Tucker's class, we designed and conducted our own research projects, what Mr. Tucker called 'project research.' We identified an environmental problem or concern in the community and went to investigate it. It was 'real' science. Of course, it took a while to set up the investigation so we had a valid experiment, but we never got bored. It was interesting to find out what's really happening right here in our own town.

"My favorite project was one Mr. Tucker called 'garbage chemistry,'" Kenneth continued. "Basically, we went to the Cedarville landfill and got some soil samples. We were finding out if a plume underneath the landfill was leaching zinc ions into nearby bodies of water. It was a nasty place, so we knew we were likely to find something. We took the samples back to school and did a wet lab workup on them, leaching out the heavy metals. From there, we took the samples to the University to be analyzed. Mr. Tucker had a partnership with the university, so we were able to conduct some complicated tests."

Recalling a similar investigation, Kenneth added: "We half expected to find heavy metals in the landfill, but on another project we found zinc and lead along the highway. We were particularly concerned to discover that these materials were migrating into a nearby water system. We wrote articles for the newspaper, went to local conferences, and several of us went to the city council meetings to let people know of our results. That's the best part of doing something real. You don't just turn the page or close the textbook, you follow through to let people know your results."

David Tucker
Mt. Baker High School
P.O. Box 95
Deming, Washington 98244

Having spoken with David earlier, we knew that his students had often found heavy metals and other concerns in soil and water from local areas. We also knew David's students take their investigations seriously. The students in his classes assume the role of scientist and design actual experiments. They develop testing procedures, provide controls, collect data, do analysis, enter data into the computer, and then write and attempt to publish their results. Many then enter a community action phase, attempting to make social, economic or political changes.



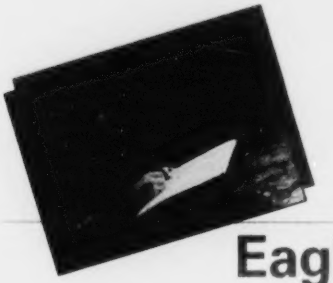
"Not all of our results are conclusive," David told us, "but my main objective is not to get results as much as it is to have students take ownership of their learning. When they get out and investigate real issues, they feel personally involved and become independent learners. When I first changed my style to a problem-solving approach to science instruction, I questioned whether I was teaching them enough science or giving them enough content. But since then, I've learned the answer is definitely yes. I believe project research is a much more effective way to teach than relying solely on a textbook."

"That's the best part of doing something real. You don't just turn the page or **close the textbook,** you follow through to **let people know** your results."

David regards his situation as fortunate, since the State of Washington has few mandates, and in his district there are no curriculum guidelines. In fact, he says that "the whole state is undergoing systematic change, encouraging curricula that are more integrated and ones that incorporate problem-solving." He sees this as a step in the right direction.

An example of change at his school is the recycling and compost program they have developed on school grounds. The school composts everything possible, including food, lawn clippings, and animal wastes from the barn on the school property. They monitor it chemically and biologically, and sell the compost. "Every teacher in the building is involved in the project. It's really had a unifying effect on the staff," says David. "It's great to share in a common project and to exchange ideas and information. Further, the excitement the project generates among the staff sets the tone for the students. The students have come to see the value of learning for its own sake."

"We're definitely headed in the right direction," David says, pausing to reflect on his own words. "I feel strongly that one doesn't need to *teach* students anything; rather, they choose to learn. Our job as educators is to provide them the necessary environment, resources, and guidance. This is the key to instilling a commitment to life-long learning in our students." ■



Eagle Project Takes Wing

"I saw three, Ms. Kelly!" exclaimed Amy, bursting in just before the homeroom bell rang. The 7th-grader had snow in her hair and a grin on her face. "One adult and two sub-adult bald eagles."

Lynn Kelly handed her student labeling pins as she searched the large county map for the right spot. After four weeks of Project Eagle Watch, she was delighted to see this apathetic student come to life.

Level
- Middle School

Story Focus
- Locating Instructional Resources
- Networking With Other Educators

Project Eagle Watch involves Lynn's students in monitoring the bald eagle population in Polson, Montana. The populations regularly vary with the severity of the winter and with the abundance of fish. But there is more to it than that. As introduced species, pesticides, and habitat loss alter the ecosystem, Lynn's students have their own data to help them understand what is going on around them.

"It's a really neat way to teach," explains Lynn, with some excitement of her own creeping into her voice. "I keep the focus on seasonal and local examples so students can see and understand what they are learning. When that happens, they are interested in what is going on, and interested students are much more fun to work with than any others!"

One key ingredient that helped Lynn create the program was joining the professionals out in the field. "They gave me the opportunity to join them in their work. This added to my excitement and made me a more enthusiastic teacher. This enthusiasm is easily passed to the students, especially when their work is contributing to something of interest outside the classroom. Besides, I'm a workaholic, and volunteering with the wildlife biologists was the excuse I needed to do something good for myself."

Lynn Kelly
Polson Middle School
111 4th Ave East
Polson, Montana 59860

Ten years ago, Lynn's volunteerism took her to Glacier National Park every November and December weekend for bald eagle roost counts. She made the wintry drive in the dark to monitor the population at dawn and dusk. It was an exciting project, and very simple. And it was something that could easily interest her seventh-graders.

All 125 of Lynn's students are involved in Project Eagle Watch from the beginning of October to the end of January. When they spy an eagle on their way home from school or out on a weekend adventure, they note the species (both bald and golden frequent the region), township range and section, distance to water, date, temperature, and the bird's activity. Back at school, their observations become colored pins in the county map and records in the database.

> "I am convinced that this project helps my students understand the **nature of scientific research,** the value of mathematics, **how to communicate** technical material, and our **responsibility to the environment**."

As in any project, some students are more interested than others, but by the end of the first month, virtually everyone is paying attention to the growing collection of pins. At that time, students begin to analyze the data. They determine the average number of adult and sub-adult eagles seen per day, and compare this ratio to previous years. These data over four months help students identify the migration peak and its possible relationship to temperature. They use map locations to detect critical winter habitat and determine the percentage of birds in each township and range. Distance to water is converted to mean, mode, and median distances.

While Project Eagle Watch occurs in Lynn's 7th-grade life science class, it is first and foremost an interdisciplinary project that emphasizes math and writing skills, as well as science. "Mathematics is one of the most sterile and least-appreciated subjects in the middle school," comments Lynn, who teaches one section of math. "The other math teachers are delighted that I can help reinforce these concepts. The kids usually don't know why a percentage or ratio is helpful, they just memorized the formula. By talking about eagles or buffalo, these math concepts have a context and finally become relevant."

The project began small and has grown every year. The latest addition is a simulated town meeting to discuss the loss of eagle habitat to subdivisions and malls. Polson, at the south end of Flathead Lake, is experiencing rapid growth in human population, and some of the heaviest development pressure is within one mile of the lake. This is precisely where students have noticed the largest number of wintering bald eagles.

"I do worry about my students' scores on standardized tests," admits Lynn, who rarely uses the text and then only as a reference book. "But, so far, they have all been well within the average range.

"I am convinced that this project helps my students understand the nature of scientific research, the value of mathematics, how to communicate technical material, and our responsibility to the environment. And because we rely on the kids and the eagles to provide our data, it is a little different each year, which makes it exciting for me." ■

Too Much Stuff

"What do we know about ourselves from our garbage?" The young student asks, strolling down the aisle between desks.

"We use too much...stuff," replies a fellow classmate.

Level
- Middle School

Story Focus
- Enlisting Administrative Support
- Locating Funding Grantwriting

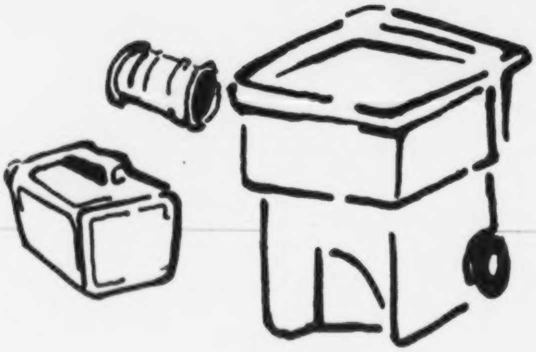
"Exactly." The young presenter says, striding to the front of the room. "A group of us from the StATS program took a look at our school: the cafeteria, the classrooms, the offices, and found that paper is the biggest category of waste by weight. We asked ourselves: 'Why is this school throwing away paper when it can be recycled and used for other things?'"

This scene has been recurring for years in the Quincy Community Schools in rural Michigan because of efforts made by Sharon Ferriss. Since she began teaching 23 years ago, Sharon has given the environment top priority in her classrooms. "I try to use the environment as a classroom topic whenever I can," Sharon says. "It is a way to bring the disciplines together, offer the students a system of ethics, and teach the problem-solving skills necessary to succeed."

Currently, Sharon is teaching gifted youngsters in the "Studies for Academically Talented Students" (StATS) program. In the StATS program, seventh and eighth graders come together once a week from their home high schools in a setting that welcomes their opinions and ideas; in this case, ideas on environmental action.

Sharon Ferriss
Quincy Community Schools
1 Educational Parkway
Quincy, Michigan 49082

A recent StATS project focused on recycling. "The students voiced an interest in recycling at the beginning of the year, and we built the curriculum around it," Sharon says. "Since they are learning about something that interests them they are extremely motivated, often taking their enthusiasm back to their home school in the form of presentations."



The project began with a survey of what was being thrown away in different areas of each student's home school. The students then analyzed the data and gave presentations in science classes at their respective home schools. They formed committees of teachers, administrators and other students in each school to develop a cost-effective plan to save paper. "It was very much a team effort," Sharon notes.

"It is a way to bring the disciplines together, **offer** the students **a system of ethics,** and teach the problem-solving skills necessary to succeed."

The resulting plan called for installing recycling containers and an educational display in each school. Students, with the guidance of teachers, wrote a proposal and received a grant from the local Wal-Mart for $750 to implement their plan.

Sharon Ferriss has organized her teaching career around environmental education. "It's an ideal way to bridge the gap between the academic world and the world that teenagers can touch, feel and that impacts their lives," Sharon says. ■

Nature Trail Into The Mainstream

Level
– Middle School

Story Focus
– Enlisting Community Support

Surrounded by Puget Sound, Vashon Island is a rural and suburban area which boasts one of the best school districts in the area. It also boasts a well-received innovation in environmental education: a nature trail conceived and organized solely by Rod Mitchell's learning disabled class.

With a background in forest ecology, Rod taught at the university level for 12 years. Since deciding that his skills were more useful to younger students, he has taught high school biology for 18 years. He now teaches a class of learning disabled students, which range from "slow learners" to autistic children.

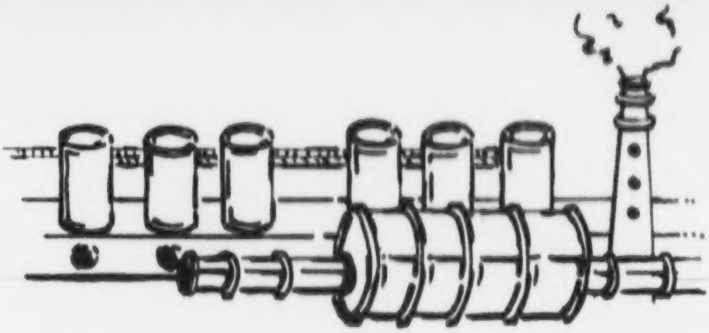
"I have a learning disability myself, and so have a special interest in doing whatever I can with these kids," Rod says, standing on the top deck of the ferry from Tacoma to Vashon Island. He already had a lot of experience with environmental education, having worked on an adopt-a-habitat program and a creek cleanup. "I found myself wanting to do something to fuse my environmental background with an interest in the learning disabled, a group of students often taught in a patronizing manner when it comes to pressing issues in the education field," he explains.

Rod Mitchell
Vashon Island High School
20120 Vashon Highway SW
Vashon Island, Washington 98070

Rod lives in Tacoma. Taking the ferry to work he watches as smoke stacks on the edge of the Sound disappear into the fog. "In this part of the country, environmental destruction is an ever-present monster, often unseen but always there," he says.

The nature trail that Rod's students developed not only connects the high school with the middle school, but extends far beyond both. "I got the idea from a project that seemed to be successful with mainsteam biology students when I was teaching in Denver. I wanted to see if it would work with learning disabled students I teach here on Vashon Island."

He leans into the ferry railing, gesturing in the air as he describes the project. Each student decided on two or three things that they could contribute to the trail, like a descripiton of a decomposing tree or a diagram of field to forest transition. Then they wrote up a description of how these contributions fit into the theme of the trail. One student designed a template in her computer class which could be used to form the descriptions into a booklet. After the booklets were photocopied, the students, on their own initiative, went to the shop teacher and made numbered signs to put up on the trail.



"The students designed a book with a pirate, the school logo, on the front and back covers to emphasize the fact that it was a Vashon project," he says. "Just because they are learning disabled doesn't mean that they are somehow separate from the school spirit."

Rod pauses. He seems to be taking inventory of his ideas. "I began the project with clear objectives in mind. I wanted to build a project which would help these kids feel connected with the school. I also wanted to teach work habits they could use in the future, reinforce a sense of self-esteem, and give them something novel, an experience which wasn't just slowed-down mainstream classwork.

"I was surprised how excited they were by the project," he continued, "and how they took the initiative to make it better. One of them wrote up an article about the trail in the school newspaper. The article spoke about future plans to take elementary students and even people from the community on guided hikes. What a great boost for the school. Something which could teach everyone a great deal about the environment around them and build the self-esteem of a group of children traditionally left out of the 'fun side' of school. I think it's great.

"It's been great involving my students in a project that brings them into the mainstream. It is amazing to me how little it takes to make a difference." ■

"I found myself wanting to do something to fuse my environmental background with an interest in the **learning disabled,** a group of **students** often taught in a patronizing manner when it comes to pressing issues in the education field."

Okra's Okay

Level
- Upper Elementary

Story Focus
- Enlisting Administrative Support
- Enlisting Community Support
- Locating Instructional Resources

The principal of Abingdon Elementary school heaped a second portion of okra onto her plate.

"I remember my grandmother making okra skillet," she reminisced aloud. "I haven't tasted anything this good since I was a little girl!"

"My grandma said she ate okra when she was little, too," offered one student.

"My grandma and grandpa said they grow their own every summer in the backyard," piped up another.

The okra Denise Leigh's first-grade class was enjoying came from Abingdon's "Old World Garden." Denise paused from cooking to explain how the garden came to be. The idea for this garden came from a program called "Seeds of Change" at the Museum of Natural History. Parents and children alike had broken ground the previous spring. For most of the children it was their first gardening experience, and some were hesitant about worms—and getting their hands dirty. But, pretty soon, they wanted to spend the whole day in the garden. "This is my plant, this is our garden, we're doing the work, and we're going to eat what we grow," was the frequent refrain. Their pride was unmistakable.

Denise Leigh
Abingdon Elementary School
3605 South Abingdon St.
Arlington, Virginia 22206

"As a result of a class discussion about what we should plant in our garden, I realized most of the children hadn't even heard of okra," Denise says. "So we decided to grow some in the garden, along with mustard greens and garlic. The soil was pretty poor at first, so we dug in a lot of compost and ended up with raised garden beds. All the work was done by hand—by the children—and we used no chemical fertilizers or pesticides. Each child started with his or her own seedling, and learned how vegetables are grown from seed, to seedling, to adult plant, to harvest."

The garden has been incorporated into every part of the first-grade curriculum. "We made the Old World connection in our Old World Garden by talking about how okra seeds came to this country in the pockets of slaves. The children also graphed the growth of the plants in the garden, and we read some stories about okra together in class. We even did some writing exercises around the recipe for okra skillet.

"The garden helps to connect students in different grades. My first-grade class from last year planted the garden in the spring, but this year's class harvested it in the fall. Come springtime, this year's students will prepare the garden for next year."

At harvest time, the okra was picked by hand. The children cautiously tested the smell, and several noticed the slimy texture on their fingers. Denise knew they'd have to get more familiar with it before they'd actually taste it. "We cut some of the okra in slices and did some okra printing on art paper," she explains. Okra has a distinctive, clover-shaped outline. Some of the okra was left on the plant to provide seed for next year.

The rest went into the okra skillet. While it was cooking, the okra revealed its slippery, slimy nature, and the kids were saying "I'm not going to eat any of that!" Denise simply told them, "If you never tasted this before, you don't know if you'll like it or not."

The result, of course, was inevitable. As Denise describes it: "I had kids asking for thirds. They were really surprised about the taste, after seeing it cook and all. The children appreciated hearing how the principal's grandmother used to make the same meal. They'd heard the same story from their own parents and grandparents, and I think that helped them to take the first bite." ■

Okra Skillet

3/4 pound fresh okra

2 to 3 ears fresh corn

1/4 cup finely cut-up lean salt pork (about 1/4 pound)

1 medium onion, chopped
(about 1/2 cup)

4 medium tomatoes, each cut into eighths

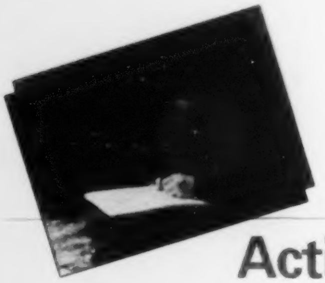
1 cup water

1/2 teaspoon salt

1/4 teaspoon of pepper

Wash okra; remove ends and cut into 1/2 inch slices. Add salt to water and heat to boil. Add okra. Cover and return to boil. Cook about 10 minutes, or until tender; drain. Cut enough kernels from corn to measure 1 cup. Cook and stir pork and onion in 10-inch skillet until pork is golden; stir in okra. Cook over medium-high heat for 3 minutes, stirring constantly. Add tomatoes and corn. Cover and simmer until corn is tender, 10 to 15 minutes. Stir in pepper.

Makes 4 servings.



Action for the Forest

As soon as I walked into my pre-Algebra class, I could tell something was wrong. Usually-lively Nicia rested her head on the desk, doodling on her notebook. Other students murmured, their voices hard with anger. A logging plan had been approved for an old-growth fir and oak forest in Goshawk Grove near the headwaters of our local river, northern California's Mattole.

Level
- High School

Story Focus
- Locating Instructional Resources
- Enlisting Administrative Support
- Enlisting Community Support
- Locating Funding Fundraising

This remnant forest was a special place to these teenagers. From previous classroom study of the ecosystem (in Environmental Studies), through numerous field trips, and as a by-product of service projects to release salmon, plant seedlings, and map the forest area, they felt connected to this patch of old growth. They understood the science and the politics of the issue, and they came down firmly on the side of protection. The previous 40 years have seen more than 90% of the ancient forest cut. The 76-acre grove facing the chainsaw was in an area that most observers saw as crucial to the health of the remaining salmon runs.

In addition to studying and understanding critical, relevant issues, our fifteen-student independent high school works to involve students in real challenges. Recognizing that our goal of active student involvement in issues might necessitate last minute changes and supersede the standard course schedule, earlier this year the staff budgeted four floating days for "political action." This occasion clearly met the criteria, and after an emergency meeting the staff and students agreed to cancel the next day's classes so we could join an anti-logging demonstration already planned at the site.

We camped upriver that night and were awakened at 4:00 the next morning by sisters from the nearby Benedictine monastery. Fortified with the tea and hot cereal they brought, we—joined by several dozen folks from the local community—hiked to the end of the road to greet the logging crew when they arrived for work. Boy, were they surprised!

Our presence prevented logging that day, since they couldn't cut trees with spectators underfoot and the sheriffs were unprepared to arrest us. We hung out with the loggers, discussing their need for a livelihood from the forest and the salmon's need for clear water—desires that all sides understood. Meanwhile, lawyers scrambled to obtain a court order that would halt the cutting while a lawsuit against the logging plan was debated.

Seth Zuckerman
Petrolia School
PO Box 197
Petrolia, California 95558

The next morning, the sheriff's deputies were ready, and in a couple of hours managed to clear the demonstrators out of the forest. As they were being led away, two students persuaded the grizzled logger they befriended the previous day to shoulder his saw and walk off the job. Within an hour, a judge issued an injunction and the cutting ceased.

The events at Goshawk Grove taught my students they could have an effect on the world—a lesson in empowerment that many of us try to teach at our schools. In this case, they were not only successful in their efforts, but they learned exactly why the demonstration was useful as a delaying tactic and how the court system could be pressed to serve a minority view.

"The events at Goshawk Grove taught my students they could **have an effect on the world.**"

Our students have had other occasions to learn the lesson of empowerment. Last year, some students joined an industrial tree-planting crew for three days to raise money for the school. Another year, when the funding for our local salmon enhancement program was cut off, students organized a campaign to get the money back. They held a press conference at the fishing harbor, wrote letters, phoned legislators, and ultimately the funding was restored. With luck, so too will the salmon. ■

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Unit 2
Taking the First Step

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Taking the First Step

Getting Your Feet Wet...

Teachers thinking about using environmental topics and activities in their classrooms for the first time may have many unanswered questions: Where do I start? Where can I find materials that will meet my classroom's unique needs? How can I identify funding sources to get my program off the ground? How can I learn more about EE? Where can I find EE in-service training opportunities?

This unit aims to answer these questions, and in the process encourage teachers to implement programs in their own classrooms. Perhaps you have tried a few environmental activities in your classroom but are stuck on where to find a curriculum that will work with your class. Or perhaps you've already had some success doing environmental education and are now looking to increase your knowledge of EE by attending an EE workshop.

The stories at the end of this unit are about teachers who recently brought EE into their classrooms. When Vicki Rich *("Things That Aren't Supposed to Be There")* wanted to incorporate environmental themes into her third-grade class, she began searching in the library for information on environmental curricula, and for names of organizations that might provide ideas. "So much material became available from so many different sources," Vicki says, "that I had no trouble creating a one-week, multi-disciplinary environmental unit." David Chapman (*"Stories Connect Past and Future"*) uses nothing but newspaper articles to bring EE into his classroom, while Sandra Jenore *("Where Do Carrots Come From?")* started her class gardening project on a lot donated by the city, with seeds and soil from the Cornell Extension Service and the Parks Department. Karen Kenna *("Empowering Emily")* attended a workshop "on a whim." She was so impressed, she started using the program in her class the next fall. "It's had a major impact on the way I teach," says Karen. "It's totally changed my perspective on teaching."

This unit contains three sections. The first section, "Instructional Materials—Where to Look," contains an overview of sources for EE materials and information. Sources range from local to regional to national and include directories of EE resources and curricula, as well as on-line information systems. The second section, "Financial Support: Easy Money?!," discusses ways to find financial resources to launch or continue your EE program. The third section, "Workshops, Courses, and In-service Opportunities," offers suggestions for teacher workshops, courses and additional training in EE.

...Without Getting Soaked!

Given the enormous scope of the topic 'the environment,' and given the wide variety of environmental education curricula, it is easy to be overwhelmed during your search for information. The problem is not that there is a lack of information, but that there is TOO MUCH.

For this reason, it is generally best to start small. If you've never done EE in your classroom before, you might begin by adding an EE activity into a lesson, then building an entire lesson around a particular theme, and then connecting a series of lessons by a common environmental thread to form a unit. Although it IS important to have enough accurate information to get started, it isn't necessary to have it ALL!

Instructional Materials–Where to Look

To design a classroom EE activity, unit or course, you do not need to start from scratch. A myriad of quality instructional resources already exist at the local, state, regional, and national levels, and many of them are easily adapted to a variety of environments and student levels. This section contains suggestions for locating resources. It contains examples of resource materials directories, instructional materials clearinghouses, and on-line information systems.

Making Use of Local Resources

One aspect of teaching about the environment that seems daunting to teachers is the complexity of many environmental issues. Many teachers simply don't feel they have the background to teach students about environmental issues. You don't have to look far to find resources that can be useful to your EE efforts.

One way to increase your familiarity with an issue is to turn to local experts. When David Marsh *("Big Sky Country Expeditions")*, needed information on the history of game management, he looked to his state's Fish and Game Commission for help. Searching for environmental professionals may also uncover resources for field trips, guest speakers, curriculum ideas and in-service training!

You may already be familiar with some of the sources listed below. You may have contacted your local historical society for information about what the early settlers ate for your history or social studies class. Or, you may have contacted your local Department of Public Works to find out more about where your garbage goes for a unit on local-resource use. You may have invited a volunteer from a local nature center to answer your students' questions. There are a number of people in your community who can help bring environmental topics to life in your classroom.

Below are some examples of local resources to contact.

"Educating Young People About Water:
A Guide to Goals and Resources"
Elaine Andrews
University of Wisconsin–Madison
Environmental Resources Center
216 Agricultural Hall
1450 Linden Dr.
Madison, WI 53706
(608) 262-0020

— **County Cooperative Extension Services** often contain a wealth of information and statewide resources. They may have information such as the recent USDA Cooperative Extension Service National Review Team's guide to water-quality curricula entitled "Educating Young People About Water: A Guide to Goals and Resources."

Marine Science Center
18743 Front Street, N.E.
P.O. Box 2079
Poulsbo, WA 98370
(206) 779-5549

— **Nature centers, county parks, local museums, scout headquarters, camps, nature reserves, and local watershed councils** often have the expertise to help answer questions and concerns regarding the local environment. The Marine Science Center in Poulsbo, Washington, for example, produces the Puget Soundbook, an attractive guide to maintaining the health of the Puget Sound region.

— **Local Library.** Libraries are not only a great source for contact telephone numbers and addresses of government agencies, but also for books and other references to use when creating your lesson, unit or curriculum. *This Planet is Mine,* a guide for concerned parents and teachers teaching environmental awareness to children, by Mary Metzger and Cynthia P. Whittaker; and *Consider The Earth,* which describes environmental activities for grades 4 through 8, by Julie M. Gates; and *The Kids Guide to Social Action,* an easy-to-use guide to teaching social action-taking skills by Barbara Lewis, are three such resources that you are likely to find at your local library.

— **Local Government.** Local planning authorities such as your County Drain Commission, City Department of Public Works, Solid Waste Department, Soil Conservation Districts, or the people with similar responsibilities, often have information on resource consumption, community development and land-use planning. Such information may, for example, be useful in developing a case study of a local environmental problem.

NOAA, Sea Grant, R/OR1
1315 East-West Highway
11th Floor
Silver Spring, MD 20910-3226
(301) 713-2431

— **Institutions of Higher Learning.** A nearby college or university can be a source of expertise or environmental education curricular materials. For example, the University of Wisconsin Sea Grant Program offers a comprehensive guide to the Great Lakes. The Ohio State University Sea Grant Program also has a series of innovative units on the lakes.

The American Architectural
Foundation at the Institute of Architects
1735 New York Avenue, NW
Washington, DC 20006

— **Local Chapters of Professional Organizations.** Many professional organizations with an environmental focus have educational materials that are available from local chapters. The American Institute of Architects, AIA, for example, has developed *Learning by Design*, a comprehensive approach to education for a quality environment. *Learning by Design* is a system of resources designed to enable educators to develop an enhanced perception of their surroundings and translate this into practical activities for their students. Contact your local AIA chapter for more information.

— **"The Source"** Sometimes the most obvious source is the most overlooked. Local utility companies, the local landfill operator, and other obvious sources often have valuable information regarding your local environment.

Resources Available at the State Level

Resources are widely available from state governments and agencies. Below is a sample of such resources. States other than those listed have similar programs.

Florida Department of Education
Office of Environmental Education
325 West Gaines Street, Room 224-C
Tallahassee, FL 32399-0400
(904) 487-7900

— **The State of Florida Office of Environmental Education** publishes, *Natural Selections*, an annual directory of success stories in environmental education. The directory profiles teachers in that state who have designed and implemented meritorious EE programs.

Office of Environmental Education
Department of Environment, Health,
and Natural Resources
P.O. Box 27687
Raleigh, NC 27611-7687
(919) 733-0711

— **The State of North Carolina Department of Environment, Health and Natural Resources Office of Environmental Education** distributes the *Environmental Education Resource Directory*, a listing of resources and educational materials. The directory is available in various formats, including hard copy, computer diskette, and via an on-line computer bulletin board.

State of Indiana's Energy Education
Curriculum Project
Office of School Assistance
Indiana Department of Education
229 State House
Indianapolis, IN 46204
(317) 232-9141

— **The State of Indiana's Energy Education Curriculum Project** offers instructional materials designed to help students become more aware of the implications of their energy choices. The curriculum consists of units on recycling, energy, water resources and air resources and includes case studies, multidisciplinary activities and a resource section.

Tennessee Energy Education Network
Anne Allen
Energy Education Specialist
Roane State Community College
8373 Kingston Pike
Knoxville, TN 37919
(615) 531-8051

— **The Tennessee Energy Education Network** publishes a list of companies nationwide that offer science-related materials that are free or under $10.

Resources Available from Federal Agencies

There are many EE materials available from the federal government and its agencies. The following are but a few examples of such sources.

- — **The Public Information Center at the US Environmental Protection Agency** offers teacher and student kits (one for K-6 and one for 7-12) of materials on subjects such as water and recycling. Many of these materials are also available from your regional EPA office.

U.S. Environmental Protection Agency Public Information Center
401 M Street SW, PM-211B
Washington, DC 20460
(202) 260-7751

- — **Regional EPA Offices.** There are ten regional EPA offices. EPA Region 4, in Atlanta, Georgia, in conjunction with other Federal, State, and local agencies, for example, has developed a comprehensive manual for teachers on the critical resource issues of their area: water quality, air quality and waste. Other EPA regions develop programs fitting the needs of the states in their region. See the resource indices at the back of this guide for your regional EPA office's address.

Tennessee Valley Authority Water Management Services
1101 Market Street
Haney Building 2C
Chattanooga, TN 37402-2801
(615) 751-3164

Global Network of Environmental Education Centers
7010 Little River Turnpike
Suite 290
Annandale, VA 22003
(703) 750-6401

- — **The Tennessee Valley Authority** has an Environmental Education center with branches at 16 colleges and universities. The branches focus on teacher enhancement, developing programs on natural resources and environmental issues, public outreach and research. The TVA works with a variety of groups to provide top quality EE teaching materials on water quality and monitoring, stewardship of public lands and other topics. TVA is currently working with the Air and Waste Management Association to produce curriculum materials for air quality and non-point pollution issues, the first of a series of teaching materials aimed at the K-12 audience. TVA also works with the non-profit Global Network of Environmental Education Centers to encourage multi-tiered partnerships and to advance environmental education and training at all levels. See the resource indices section in this guide for the TVA-sponsored EE center nearest you.

Department of Energy
Office of Environment, Safety and Health
Forrestal Building
1000 Independence Avenue, SW
Washington, DC 20585
(202) 586-6151

- — **The Department of Energy's** *Partnership for Environmental Technology Education (PETE)* program provides materials development, instructor training, and student support by training environmental technicians and encouraging the pursuit of four-year degrees in environmental science, engineering, and management. The *Global Climate Change Curriculum* provides materials development and teacher enhancement in which interdisciplinary materials are developed by teachers in conjunction with laboratory scientists. Workshops are taught by teachers for other teachers who wish to use global climate change materials in their classrooms.

Department of Education
400 Maryland Avenue, SW
Washington, DC 20202
(202) 401-3679

— **The Department of Education** offers financial support for in-classroom environmental education programs nationwide through the *Eisenhower Mathematics and Science Education* program, which focuses on raising the competency of high school graduates in science and math.

Department of Health
and Human Services
Center for Environmental Health
and Injury Control
1600 Clifton Road, NE
Washington, DC 30333
(202) 619-0257

— **The Department of Health and Human Services'** Public Health Service education programs help the public learn about environmentally-related health issues. Through the National Institute on Environmental Health Science's *Summers of Discovery* program, the DHHS also offers summer internships for high school students and teachers to participate in environmental health research at NIEHS laboratories.

National Aeronautics
and Space Administration
Education Division
300 E Street, SW
Washington, DC 20546
(202) 358-1110

— **The National Aeronautics and Space Administration** provides environmental education through community outreach programs associated with the Kennedy Space Center and Wildlife Refuge in Florida. The *Student Ground Truth Studies Project*, for example, is aimed at teaching K-12 students about their local environment and how it relates to global change.

Department of the Interior
Office of Environmental Affairs
1849 C Street, NW
Washington, DC 20240
(202) 208-3891

— **The Department of Interior** offers hands-on learning and research in outdoor laboratories provided by the nation's public lands through its many service branches. For example, the *Water Education for Teachers* program and *Water Resources Education Initiative* evaluate, develop, and disseminate materials on water resource protection and conservation issues through teacher seminars, workshops, and National Science Teachers Association publications. The *National Parks as Classroom* program provides guided walks, exhibits, and audiovisual presentations at national parks to students and the public on various natural history and environmental protection issues.

Department of Agriculture
Natural Resources and Environment
Environmental Coordination
Auditors Building
Fifth Floor SO
201 14th Street, SW
Washington, DC 20090-6090
(202) 720-7173

— **The Department of Agriculture** conducts elementary, secondary, and undergraduate education as well as public programs that include materials development, teacher and faculty enhancement, student support and recruitment, and public science literacy activities. In the area of Environmental Education, these include the *Don't Bag It, Better Lawns and Gutters, Environmental Landscape Management, C-Scape,* and *Baywatch* programs which improve public science literacy by teaching homeowners about managing their yard waste with sensitivity to local concerns such as waste reduction, water protection and conservation, and habitat values. The *Urban Treehouse* and *Summer of Service* programs teach inner-city youths about resource conservation. The *Project Minority Outreach Recruitment Education/Employment* program encourages minority youth to enroll in college programs and to pursue careers in fields that include natural resource management, mathematics, and science.

National Oceanic and
Atmospheric Administration
Office of Educational Affairs
1825 Connecticut Avenue NW
Suite 329
Washington, DC 20235
(202) 606-4380

— **The National Oceanic and Atmospheric Administration** *Summer Institute for Science and Math* provides teacher enhancement in the earth and environmental sciences for middle and high school teachers on topics such as climate change, ozone depletion and acid rain. Through its state-based *Sea Grant Programs*, NOAA supports numerous EE programs. In addition, the Sea Grant Program has supported more than 10,000 students in the study of marine sciences and affairs since 1966.

National Science Foundation
Stafford Place
4201 Wilson Blvd.
Arlington, VA 22230
(703) 306-1234

— **The National Science Foundation** assists middle schools and high schools in developing environmental education curricula. For example, *An Investigative Laboratory to Enhance Environmental Science Education and Teacher Preparation* program at Middlebury College in Vermont gives pre-college science teachers opportunities to teach science from an inquiry-based perspective.

Non-Profit Organizations

Non-profit groups often make curriculum materials available to educators. Three groups are listed below. For a more complete listing of non-profit organizations, see the resource indices section at the end of this guide.

The Sierra Club
National Legislative Office
408 C Street, NW
Washington, DC 20002
(202) 547-1141

For the *Green Guide*
write to the following:
The Sierra Club
Dept. SA
P.O. Box 7959
San Francisco, CA 94109
(415) 923-5660

— **The Sierra Club** produces the *Green Guide*, a listing of free and inexpensive materials such as factpacks, posters, activity suggestion and guidelines for exhibits. In addition, with branch offices nationwide, the Sierra Club provides valuable information and support for EE program development.

National Wildlife Federation
1400 Sixteenth Street, NW
Washington, DC 20036-2266
(202) 797-6800

— **The National Wildlife Federation's** *Earth Tomorrow: An Urban Challenge* is a program for high school sophomores focusing on positive aspects of the urban environment and involving students in environmental projects in their schools and communities.

Friends of the Earth
218 D Street, SE
Washington, DC 20003
(202) 544-2600

— **The Friends of the Earth** publishes an *Environmental Education Resource Guide* to informational resources, curriculum materials and children's books covering environmental themes.

Project Eco-School
881 Alma Real Drive
Suite 300
Pacific Palisades, CA 90272
(310) 454-4585

— **Project Eco-School** is an international, non-profit Environmental Education Resource Center that serves as a network for environmental educators and organizations. In addition, they publish *Blueprint for a Green School*, an Environmental Education resource guidebook.

Program Development Resources

Several detailed resources exist to assist educators develop an environmental education program. Among these are:

— ***Essential Learnings in Environmental Education,*** published by the North American Association for Environmental Education (NAAEE), is a collection of concepts viewed as "essential for environmental literacy." It is designed to act as a database for building environmental education activities and programs and as such will assist teachers in choosing objectives for their programs.

NAAEE
Publications and Membership:
P.O. Box 400
Troy, OH 45373
(513) 676-2514

— ***The Environmental Education Teacher Resource Handbook: A Practical Guide for Teaching K-12 Environmental Education,*** Richard Wilke, editor, is a reference designed to provide basic information on the background of environment curriculum, as well as current information on publications, standards, and special materials for K through 12 educators.

Environmental Education Teacher Resource Handbook
Kraus International Publications
358 Saw Mill River Road
Millwood, NY 10546-1035
(800) 223-8323

— ***Environmental Education in the Schools: Creating a Program That Works!,*** by Judy Braus and David Wood, was written for Peace Corps Volunteers who teach in classrooms around the world and who are building environmental education into their school system. It describes in detail how to create an EE program and provides many well-tested activities available from several sources.

Environmental Education in the Schools: Creating a Program That Works!
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
(703) 487-4650

— ***A Guide to Curriculum Planning in Environmental Education,*** by David C. Engleson, is a manual for teachers and school districts that introduces and explains environmental education, value development, relevant teaching methods, and a process for infusing environmental topics into the existing curriculum.

A Guide to Curriculum Planning in Environmental Education
Wisconsin Department of Public Instruction (Publications)
125 South Webster Street
P.O. Box 7841
Madison, WI 53707-7841
Toll free: (800) 243-8782
In Wisconsin: (608) 266-2188

— ***The Journal of Environmental Education*** is a quarterly publication published in association with the North American Association for Environmental Education that features articles on current trends in the field of environmental education.

The Journal of Environmental Education
Heldref Publications
1319 18th Street, NW
Washington, DC 20036-1802
(800) 365-9753

Directories of EE Resources

You may want to begin your search for materials with a directory of EE resources. Several groups publish directories of EE materials, most of which include a brief description of the curricula or materials, suitable grade levels and contact addresses. There are several such entities around the country, and more being developed. Some of these are listed below.

National Wildlife Federation
144 Sixteenth Street, N.W.
Washington, DC 20036-2266
(202) 797-6800
To order the *Conservation Directory*:
(800) 432- 6564
(Ask for item #79560)

— **The National Wildlife Federation's** *Conservation Directory* lists environmental departments, agencies, and offices of approximately 2,000 U.S. Government agencies, international, national and regional organizations and commissions, colleges and universities with conservation programs, state environmental agencies and citizens' groups, and Canadian government agencies and citizens' groups.

Northeast Field Guide
Antioch New England Graduate School
Roxbury Street
Keene, NH 03431
(603) 357-3122

— ***The Northeast Field Guide,*** covering the 9 Northeastern states (CT, MA, ME, NH, NJ, NY, PA, RI and VT), describes more than 400 organizations, including nature centers, EE centers, planetariums, aquariums, zoos, environmental and science museums, state agencies and state park offices, national parks and wildlife refuges, other environmental directories, EE conferences, environmental job publications and resources, and state, regional and national EE organizations. There are also indices by name and by state with program levels cross referenced.

Harbinger Communications
250 Homestead Trail
Santa Cruz, CA 95060
(408) 429-8727

— ***The Harbinger File-California Environmental Directory*** is a descriptive directory of 1,040 organizations concerned with environmental issues in California.

Rocky Mountain Directory
8850 O'Brien Creek Road
Missoula, MT 59801
(406) 543-3359

— ***The Rocky Mountain Environmental Directory*** lists and describes nonprofit organizations, government agencies, and other organizations in the Rocky Moutain region concerned with environmental education and action.

To order the *1993-94 People of Color Environmental Groups Directory*:
Charles Stuart Mott Foundation
503 South Saginaw Street
Flint, MI 48502
(313) 238-5651

— ***The People of Color Environmental Groups Directory 1992*** is a listing of 205 people of color groups nationwide that are working on environmental issues. The 1992 edition is also available on EcoNet (see On-Line Information Systems). The 1993-94 edition, to be distributed by the Charles Stuart Mott Foundation, is due out in Spring of 1994.

California Compendium Project
Bill Andrews
Education Programs Consultant
Science and Environmental Education Unit
California Department of Education
721 Capitol Mall
P.O. Box 944272
Sacramento, CA 95814
(916) 657-5374
Publication Sales Office:
(916) 445-1260

— **The California Department of Education's** *California Compendium Project,* is a series of compendia which provide information on quality environmental education materials. The materials in each compendium were evaluated for presentation, pedagogy, general and topic-specific content, and teacher usability to help educators locate curricula that are up-to-date and accurate. The series, produced in conjunction with a variety of California state agencies, includes a *Compendium for Energy Resources*, a *Compendium for Water Resources* and a *Compendium for Integrated Waste Management.* By 1994 the Project will add compendia on the following topics: air quality, human communities, and natural communities.

Clearinghouses and Resource Centers

At times, of course, it is easier to contact a library, a clearinghouse, a resource center or other huge collection of information. There are several such entities around the country, and more being developed. Some are listed below.

- **The U.S. EPA** and the **National Consortium for Environmental Education and Training** are developing a computerized Resource Library of instructional materials, lesson plans and video clips.
- Several states including **Florida, Colorado, Arizona and Minnesota** maintain or are developing clearinghouses of environmental education resources. Teachers in these states can look forward to a wealth of information available to them through a phone call or computer request. Contact your state EE coordinator or Department of Education for more information concerning opportunities in your area. See the resource indices for the name and address of your state's EE coordinator.
- **Creative Educational Networks** produces *Clearing* a magazine for educators in the Pacific Northwest that describes current issues, resources, activities and ideas in environmental education. Teachers outside the region may also find it a useful resource.
- **The Clearinghouse for Science, Mathematics, and Environmental Education** is one of 16 US. Department of Education sponsored Educational Resource Information Center clearinghouses. A list of EE publications produced by ERIC/CSMEE can be requested by phone.
- **The Renew America** *Environmental Success Index* is an annual listing of 70 or so exemplary environmental programs from across the nation, a clearinghouse for innovative ideas and established projects. Renew America seeks out programs around the nation, whether large or small, that effectively protect, restore or enhance the environment. Renew America is a non-profit, tax-exempt clearinghouse for environmental solutions.
- **Technology Education Research Center.** TERC is an independent, non-profit organization founded in 1965. It develops software and curriculum materials, including telecommunications-based educational programs, and works with schools to implement innovative programs in math and science.

U.S. Environmental
Protection Agency
Environmental Education Division (1707)
401 M Street SW
Washington, DC 20460
(202) 260-4962 or (202) 260-4965

NCEET
School of Natural Resources
and Environment
University of Michigan
Ann Arbor, MI 48109
(313) 998-6726

Creative Educational Networks
John Inskeep Environmental
Learning Center
19600 S. Molalla Avenue
Oregon City, OR 97045
(503) 656-0155

ERIC/CSMEE
Information Reference Center
1929 Kenny Road
Columbus, OH 43210-1080
(614) 292-6717

Renew America
1400 16th Street, NW
Suite 710
Washington, DC 20036
(202) 232-2252

TERC
2067 Massachusettes Avenue
Cambridge, MA 02140
(617) 547-0430

The Pembina Institute
P.O. Box 7558
Drayton Valley
Alberta, Canada T0E 0M0
(403) 542-6272

— **The Pembina Institute,** a citizen-based, non-profit environmental organization produces *The Canadian Environmental Education Catalogue,* a guide to selected EE resources. The catalogue features more than 1600 resources, each with bibliography, price, and ordering information. The catalogue (also on disk) lists resources from both Canada and the United States.

The Environmental Exchange
1718 Connecticut Avenue
Suite 600
Washington, DC 20009
(202) 387-2182

— **The Environmental Exchange** supports local environmental action by promoting solutions. They act as a clearinghouse of information on a range of successful environmental initiatives including air pollution, transportation alternatives and toxics. Environmental Exchange publishes a series of *What Works* reports, which highlight model programs – including a section that highlights programs at schools, colleges, and universities – and provide contact information for these projects.

On-Line Information Systems

EcoNet
Institute for Global Communications
18 DeBoom St.
San Francisco, CA 94107
(415) 442-0220

— **EcoNet** is an on-line communications system operated by the San Francisco-based Institute for Global Communications. It was designed solely to facilitate the exchange of ideas and information concerning environmental issues and environmental education.

GAIN
575 Soquel Avenue
Santa Cruz, CA 95062
(408) 457-0130
EcoNet: <gain>
Internet: gain@igc.apc.org

— **Global Action & Information Network** is a network of concerned organizations and people—activists, educators, public officials, business owners, students and others—linked by their commitment to create a sustainable world through broad-based citizen action. GAIN is a communication network, a referral service, an information bank, a forum for new ideas, a support system, a source of inspiration and much more.

EELink
National Consortium for Environmental Education and Training
School of Natural Resources and Environment
University of Michigan
Ann Arbor, MI 48109
(313) 998-6726
Internet:
eelink@nceet.snre.umich.edu

— **The National Consortium for Environmental Education and Training's EELink** will help guide K-12 teachers to useful EE materials that exist throughout the Internet, a network connecting thousands of computers at universities, government agencies and non-profit organizations around the world. The Internet provides a particularly rich supply of resources. EELink will also serve as an outlet for materials collected and produced by NCEET. Electronic versions of NCEET materials will be posted on EELink as they become available. All resources on EELink will be provided free of charge.

To order NetPower:
Fox Chapel Publishing
Box 7984
Lancaster, PA 17604
(800) 457-9112
Internet:
'NetPower1@aol.com'

— **The National Education and Technology Alliance,** a not-for-profit organization dedicated to promoting network use in education, offers a guide to on-line computer services called *Netpower: Resource Guide to On-line Computer Services.*

Florida Resources in Environmental Education (FREE) for Teachers
Florida Department of Education
Office of Environmental Education
325 West Gaines St.
Room 224 C
Tallahassee, FL 32399-0400
(904) 487-7900
In Florida: (800)342-3733

— **Florida Resources in Environmental Education,** a computerized clearinghouse developed by the State of Florida Office of Environmental Education, provides teachers in that state with on-line access to EE information. It consists of 5 databases: student conservation groups, EE speakers, funding opportunities, and EE materials, and programs.

Financial Support— Easy Money?!

This section identifies a variety of different funding sources. This list is not comprehensive. It is a grab bag of ideas that will hopefully lead you to other possibilities in and around your own community.

EE On a Shoestring

Not all projects or lessons will entail financial cost. In Unit One, for example, we presented the story of Lydia Hamn *("The Most Appealing Peanut")* who had her students just bring in a peanut, and that was the seed for an entire lesson. We also presented David Chapman *("Stories Connect Past and Future")* who used local newspaper articles and his skill as an educator to bring environmental themes into his classroom. In this unit, we introduce Mary Jo Terminello's story *("The Greening of Dania")*. When Mary Jo's third-grade students decided to "re-forest" their barren school grounds, they developed a "baggie brigade." Mary Jo sent them home with plastic sandwich bags and asked them to bring them back the next day filled with soil.

It is important to note that although you may experience difficulties funding your project, the resources DO exist... the challenge is finding them. When Sandra Jenore *("Where Do Carrots Come From?")* wanted to create a school garden in an adjacent lot for schoolchildren and families, she approached the Cornell Extension Service and the Parks Department for assistance. They sent seeds, tools, bulbs and flowers. To help cover the cost of her EE efforts, Mary Anne Challa *("Themes For a Lesson Plan")* applied for a small service learning grant from her school's P.T.A. And Sharon Ferriss' students *("Too Much Stuff")* asked the local Wal-Mart for financial support for their recycling program.

In-House Support

The best place to search for funds is with groups that will directly benefit from your program. For some, the search need not go further than their own classrooms. Gary Smith *("Have You Seen My Slender Salamander?")* and Seth Zuckerman *("Action For The Forest")* found that they had both talented fundraisers and successful entrepreneurs in their classrooms. Involving students in the financial aspects of program development can provide them with additional experiences and increase their level of commitment to the program. These teachers' innovative funding approaches illustrate basic techniques and approaches that can be adapted to meet local conditions and needs.

In addition, your school may have funds available for your project. In some schools, the P.T.S.A. and the Teachers Union award funds to innovative school-improvement projects.

Financial Support in Your Community

Local businesses and community organizations are a source of financial and professional support. Jerri Kelly *("Mangrove Monitor Madness")* received financial support for her EE efforts from local merchants, the County Soil and Water Conservation District, and the local Association for Excellence in Education. This section provides suggestions for how to approach your contacts and where to begin your search.

How to Approach Your Contacts

- **Identify a contact person.** In many cases it will take a few phone calls to locate the person who can give you the time and information you need.
- **Write a brief cover letter.** In the letter, explain why you are contacting the individual or organization. Share your vision. Describe how you see your program blossoming in the future. Talk about similar programs that have expanded to school-wide programs, regional endeavors, state projects or even national initiatives. Also, state that you would like to discuss the ideas in more detail at a later date, and that you will be contacting them on a certain day.
- **Make an appointment to discuss your proposal in person.** Meeting with an individual ensures that you will have the time you need to cover your ideas and questions.

— **Be prepared for your meeting.** Bring a detailed description of the program you intend to develop or implement. Show your enthusiasm. Let your audience know that you are serious about your plan, and that you value any information they can share.

— **Get a commitment.** Talk specifics and establish a definite role the particular individual or organization will provide.

— **Follow up.** Send a thank you letter and periodic updates about how your program is progressing. After all, it has become their program too.

Local Community Groups

The main idea to keep in mind when soliciting support is to approach organizations compatible with your program's needs. For example, when starting an Old World Garden at her school, Denise Leigh *("Okra's O.K.")* looked to the Museum of Natural History's "Seeds of Change" program for assistance. Other groups include:

— Religious organizations
— Garden clubs
— Urban greening groups
— Civic organizations like the Junior League, Kiwanis and the Jaycees
— The city forester
— Youth organizations like the Boy and Girl Scouts, and 4-H
— Professional associations, such as the National Association of Landscape Architects, and Air and Waste Management Associates
— Local chapters of national environmental groups such as the Sierra Club, The Nature Conservancy and The Audubon Society
— Local art groups

Local Businesses

Businesses are increasingly aware of the appeal of "green" activities on a growing body of "green" consumers. This awareness translates into a heightened willingness to fund high-profile EE programs. Local educators can utilize this opportunity to galvanize financial support for their environmental education programs.

While the largest employer in your region might be the best place to begin your search, the potential contributions of less-visible local firms should not be overlooked. Utility companies, for example, are often among the most supportive of environmental education. Bonnie Trusler's *("The Energy Patrol Strikes")* students monitor the school's energy consumption on a meter developed for the school by the local utility company. Examining your business community in your region should help identify a list of potential funding sources unique to your area. Here are some other ideas:

- Food store chains and restaurants
- Retail outlets
- Law firms and legal associations
- Local branch of a national company with environmental interests
- Local industry councils and the chamber of commerce
- Local television stations and other media
- Insurance companies
- Local hospitals, zoos and banks

Local Government

Local government offices– from the mayor's office to the city parks and recreation department– are often able to provide valuable financial assistance. While tight budgets make it difficult for local governments to provide direct funding, the advantages of developing a relationship with community leaders are substantial. It may be easier for agencies to fund projects that offer needed services to a particular segment of the community. Here are some other suggestions:

- City or county recycling coordinators
- The city commissioner and other officials' offices
- County agricultural centers, and water and conservation districts
- Local parks and nature preserves
- State and local museums

Workshops, Courses, and In-service Opportunities

EE workshops are an excellent way to increase your knowledge of environmental education. EE workshops are often offered by nature centers, museums, colleges and universities, and state natural resource agencies. Many school districts, intermediate school districts, and regional education service centers offer pre-service and in-service credits for attendance and are responsive to teacher requests for workshops. Contact a local nature center or museum, or your state's Department of Education Office of Environmental Education, Department of Natural Resources, or Environmental Education organization or association for a list of EE in-service opportunities in your state. See the resource indices at the end of this guide for those contact addresses.

Through the Eisenhower program, which focuses on raising the competency of U.S. high school graduates in science and math, the U.S. Department of Education offers financial support for in-classroom EE programs around the country. Often, such funds are available for teacher training.

This section identifies a variety of different workshops, courses, and in-service opportunities. Examples currently offered to teachers throughout the country include:

Coyote Point Museum
for Environmental Education
1651 Coyote Point Drive
San Mateo, CA 94401
(415) 342-7755

— **The Coyote Point Museum** in San Mateo, California, hosts a variety of EE workshops for pre-kindergarten through 12th-grade teachers. Workshops emphasize hands-on, multidisciplinary activities and include topics from wildlife and forests to energy and nature photography. College credit is available.

Aspen Global Change Institute
100 East Francis Street
Aspen, CO 81611
(303) 925-7376

— **The Aspen Global Change Institute** is a forum for global change researchers to further understanding in global change science. The Institute offers workshops introducing teachers to various concepts of global change, including Ground Truth Studies. AGCI also provides teachers with support materials such as remotely sensed images and educational videos.

Three Circles Center for Multi-Cultural
Environmental Education
P.O. Box 1946
Sausalito, CA 94965
(415) 331-4540

— **The Three Circles Center for Multi-Cultural Environmental Education** serves to introduce, encourage and cultivate multicultural perspectives and values in environmental and outdoor education, recreation, and interpretation. TCC offers workshops and in-service training in the development of programs and curriculum to better meet the needs of culturally diverse populations.

SEPUP
Lawrence Hall of Science
University of California
Berkeley, CA 94720
(510) 642-8718

— **The Science Education for Public Understanding Program (SEPUP),** provides summer trainings and workshops throughout the country for middle and high school teachers. SEPUP educational materials use societal issues as a focus on how science and technology can be used as a basis for evidence based decision making. Some of the module topics are: Plastics in Our Lives; Household Chemicals; The Waste Hierarchy: Where is AWAY?

— **Project Learning Tree (PLT), Project WILD and Project WET** are three examples of nationwide EE programs that offer training workshops on the use of their environmental education materials. PLT is an interdisciplinary curriculum which uses trees as the vehicle for exploring our use of forest resources. Project WILD is a set of interdisciplinary activities based on wildlife, animal ecology, and the human connection to wild animals. Project WET is a set of interdisciplinary activities based on water quality and water ecosystems. In each case, a six hour training workshop is required in order for teachers to be allowed to use curriculum materials. Workshops are coordinated by the PLT, WILD, or WET coordinator in your state. Contact the PLT, WILD, or WET national office or your state's EE Association or Organization, Department of Education EE Coordinator, or Department of Natural Resources for the name of the PLT, WILD, or WET coordinator in your state. See the resource indices at the end of this guide for those addresses.

Project Learning Tree
1111 19th Street NW, Suite 800
Washington, DC 20036
(202) 463-2462

Project WILD
5430 Grosvenor Lane
Bethesda, MD 20814
(301) 493-5447

Project WET
201 Culbertson Hall
Montana State University
Bozeman, MT 59717
(406) 994-5392

— **The Department of Curriculum and Instruction at Southern Illinois University** offers teacher training designed around "Investigating and Evaluating Environmental Issues and Actions," a curriculum development project designed to teach students how to investigate and evaluate science-related social issues. (See "*Empowering Emily*").

Investigating and Evaluating Environmental Issues and Actions–IEEIA
Department of Curriculum and Instruction
Southern Illinois University
Carbondale, IL 62901
(618) 453-4214

— **The Department of Environmental Studies and Planning at Sonoma State University** offers a wide variety of workshops for kindergarten through 12th-grade teachers. Workshops emphasize hands-on resources. The on-campus Earth Lab, which is used extensively for teacher training, features demonstrations of sustainable agriculture and energy.

Department of Environmental Studies and Planning
Sonoma State University
1801 E. Cotati Avenue
Rohnert Park, CA 94928
(707) 664-2306

— **The University of Wisconsin–Stevens Point** offers a series of graduate credit courses for teachers in environmental education. Courses are offered across the state by professional environmental educators, trained as ad hoc faculty. On-campus summer courses enable teachers to earn a masters degree in EE. Many colleges and universities, especially those with extension programs, offer evening, weekend and summer courses for in-service teachers.

Learning Resources Center
Wisconsin Center for
Environmental Education
University of Wisconsin-Stevens Point
Stevens Point, WI 54481-3897
(715) 346-4973

National Diffusion Network Recognition Division
U.S. Department of Education
OERI/PIP/Recognition Division
Room 510 East
555 New Jersey Avenue N.W.
Washington, DC 20208-5645
(202) 219-2134

WOW!: The Wonders of Wetlands
Environmental Concern, Inc.
P.O. Box P
St. Michaels, MD 21663
(410) 745-9620

— **The National Diffusion Network** is an organization that shares successful education programs among public and private schools, colleges and other institutions. Administered by the U.S. Department of Education, the NDN provides funds to distribute information about exemplary programs to schools across the country. The NDN coordinator in your state can give you information about how to bring a workshop to your area.

— **WOW!: The Wonders of Wetlands** is a 160 page comprehensive educators' guide that provides multidisciplinary classroom and outdoor learning activities for all grade levels. It includes over 40 activities exploring different wetland types, soils, water, plants, and current issues, as well as sample hands-on restoration and enhancement projects. The curriculum guide is supported by national teacher training workshops administered by Environmental Concern, Inc. [In late 1994 Environmental Concern, Inc. will join resources with National Project WET to re-issue WOW!: The Wonders of Wetlands as the Wetland Discovery Module, a supplement to the Project WET Curriculum & Activity Guide.]

"Z" is For Zero-Waste

"Now I know my environmental A-B-C's, next time won't you sing with me!" Wait, was that "*environmental* A-B-C's?" We are all familiar with the tune, but Leslie Dahlquist has changed the words to reflect the times. Rather than "A is for Apple" and "B is for Ball," her kindergarten and first-graders' A-B-C's begin with "A is for Aluminum." The first week in school, they learn about recycling and practice it all year long. Each week, Leslie introduces a new letter and a new environmental subject to study.

Level
- Lower Elementary

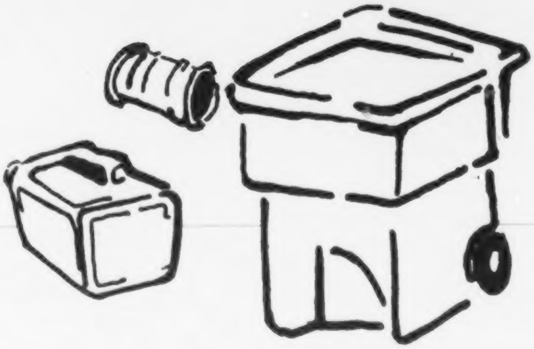
Story Focus
- Locating Instructional Resources

Leslie began integrating environmental education into her classroom eight years ago. Since that time she has created activities such as "pennies for ecology" (students bring in pennies to be used in math lessons and then collect them to use to buy trees for the school), and planted an organic vegetable garden on school property. Three years ago, she used the children's creativity (all artwork was made by the children), along with her own, to develop the environmental A-B-C book. She has since used it as a guideline for the entire school year, using it to plan lessons that connect and integrate material from various subjects.

The book covers many topics, introduces vocabulary, and presents activities for the week. "C," for example, is for carpool. That week, the children learn about alternative transportation methods and experiment with different ways of getting to school and other places.

Leslie Dahlquist
Topanga School
141 North Topanga Canyon Boulevard
Topanga, California 90290

In addition, the curriculum covers social studies and science. "E," for example, is for endangered and the class usually adopts "Patches," a humpback whale, an endangered species. They imagine and plot Patches' migration route on a map and talk about the dangers and threats Patches faces along the way. "H" stands for helium, leading the class to a discussion of the threats that released helium-filled balloons pose to wildlife. The students consider the suffocation risk for sea life that mistakenly eat balloons.



"J" is for junk. This letter begins a discussion about landfills and incinerators and the growing problem of finding a suitable place to put our garbage. The children question what garbage is, and gain an understanding that many things thought of as garbage are good for other uses when recycled or otherwise re-used. This leads to "trade your junk day," when students bring their "junk" to trade with others who may want it. Of course, they quickly realize that one child's junk is another's treasure.

"Rather than **A is for Apple** and **B is for Ball,** her kindergarten and first-graders' A-B-C's begin with **A is for Aluminum.**"

"Q" is for quality. This week the children refresh their knowledge of recycling and garbage as they introduce issues relating to math, business, science and art. They talk about items they buy that last long and those that don't, and try to find the differences in them. Issues of goods, services, production and price are introduced.

The object of the last week of the school-year is to produce zero or as little waste as possible: "'Z" is for zero-waste. The week culminates with a zero-waste lunch, in which the whole school participates. By then, Leslie Dahlquist's students have certainly learned much more than their A-B-C's. ■

Learning on the Job

John Scheer occasionally describes his teaching as taking off into parts unknown. "We never let not knowing stop us," he says. "One of our objectives at Phelps School is to focus on student interests, even if it means teaching a course we're not entirely comfortable with. In such cases, I simply learn right along with my students."

John says this was the case with an environmental course he recently co-taught with Wes Leggett, the media teacher.

Level
- Middle School

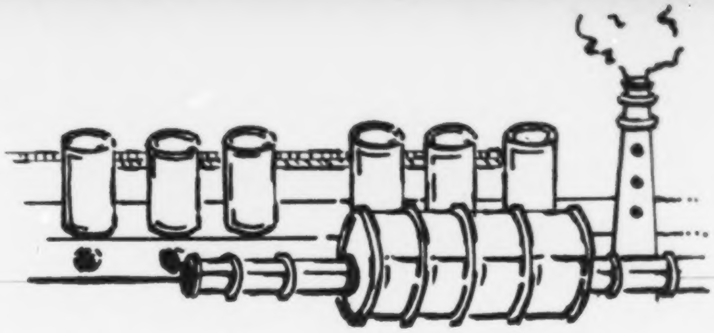
Story Focus
- Enlisting Administrative Support
- Locating Instructional Resources
- Networking With Other Educators

Originally, the course grew out of a concern for water quality. A number of students who lived close to the nearby Fassnight Creek were dismayed by the creek's looks and smells and wanted to do something about it. In particular, says John, "there was a lot of oil scum on the surface of the water and a great deal of garbage along its banks. The students had all kinds of questions about how it effects the environment and the animals that live by the creek."

Even though John knew little about the creek's problems, it seemed like a worthwhile investigation to continue, in part because the kids were so excited. "I had to do my homework along with the students," says John. "Plus, I talked quite a bit with the former teacher of the course." With so many issues affecting water quality, the students had their hands full. The school didn't have the equipment to analyze water quality in the creek, but they were able to team up with the city to run tests. In addition to oil and garbage, they found the creek was overloaded with nutrients. They also discovered plans to further channelize it.

John Scheer
Phelps Center for the Gifted
Springfield, Missouri 65806-3397

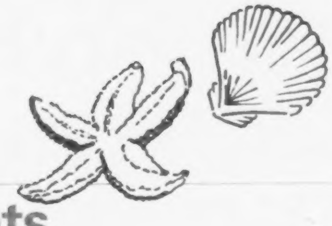
The students gathered their information, assembled spokespeople and headed to a city council meeting to argue for tighter zoning around the creek. Since then, some students have created pamphlets explaining different ways to help clean up the creek, while others have made educational videos now used by the Missouri Department of Conservation. "It's really rewarding for me to see the students' growth and commitment to solving some of these problems," John says.



"Sometimes the issues of our class are more personal, as well," John adds. "When we were looking at another creek this year in comparison to Fassnight Creek, one of the students found a goldfish amongst a school of minnows. This set off a discussion on what it feels like to be unique and different. Just by coming to this school, students often get labeled as 'geeks' or 'encyclopedia heads'. So we spent the hour talking about what it feels like to be different, how prejudices are perpetuated and what some of the coping skills are. I think it was a valuable discussion, one that fit well with our curriculum goals.

"We work hard to find the interests of our students, and build on these interests and strengths. It's a little different style of teaching: You have to be open and willing to move from one thing to another. Once you get involved, you find a whole new joy in teaching, and the students are thriving as well." ■

"It's a little different style of teaching: you have to be **open and willing** to move from one thing to another. Once you **get involved,** you find a whole new joy in teaching, and the **students are thriving** as well."



Adapting Assignments

As you approach Tim Fowler's science classroom, the walls are covered with posters of the Chesapeake Bay. Oysters filter water for plankton meals, people fish along the shore, blue crabs wave a claw and a deer bounds for cover. Inside, students are busy working in groups around small, black lab tables.

Level
- Middle School

Story Focus
- Locating Instructional Resources
- Enlisting Community Support

"Let's keep it down," Tim reminds the class. "Talking louder won't tell you who eats oysters, Adam, you'll have to look it up." Tim strolls through the groups and checks their Bay food web.

Tim teaches in Baltimore, Maryland, where the Chesapeake Bay impacts local industries, transportation and recreation. It is also a huge, dynamic, threatened estuarine ecosystem. Tim's curriculum helps the students identify the animals and plants that live there, and, in some cases (like the crayfish), to observe them.

"Science texts, even when the topic is the environment, don't do a good enough job helping kids understand the complexities of the real world," Tim says. "The typical approach is to separate the animals from their environment. Students are asked to count crayfish legs and learn where eggs are carried. The texts don't help kids learn how the animal interacts with others, where it lives or where it hides. Students also need to know about human uses of the Bay, nutrient loading, shipping channels, and over-fishing. Since this information isn't in the science books, I add it."

Tim Fowler
Pikesville Middle School
7701 Seven-Mile Land
Baltimore, Maryland 21208

In this four week unit, Tim's classes explore topics with exercises, discussions and research projects. The adventure culminates in a group task, where students design a poster of the Bay, identifying at least 15 organisms and placing them in their proper habitat. They also create accurate food webs for the same organisms. His only requirements are that the posters include phytoplankton, zooplankton and a human. Posters help students integrate the different parts of the Bay they have studied.

"It might sound simple, but it is a difficult assignment," Tim says. "They have to hunt through the reference materials before they can be sure about what a blue crab eats."

Tim adapted this activity from the standard Baltimore County curriculum materials. In its original form, it was an optional art activity. Worksheets for the new activity came from the Chesapeake Bay Foundation, a local environmental organization. Tim added constraints, demanded accuracy, and put the students in small groups. He prefers to change individual activities into cooperative group exercises to help students learn cooperative skills. Listening, sharing, leading and being responsible are just as important as measuring and hypothesizing, and often make an assignment more interesting and fun. Tim created roles for each group member to help guide their task.

"Students also need to know about human uses of the Bay, **nutrient loading, shipping channels**, and **over-fishing**."

Tim's five classes range from gifted students to potential drop-outs, so he further adapts the assignment for each. Small changes create something that is challenging yet achievable. "Some classes are given a diagram of the Bay and they fill in the organisms," Tim says. "Others draw their own, and sometimes get quite creative. Two groups this year are trying an aerial view. I don't know if they'll be able to portray three habitats or not." More complex interactions are expected in the food webs designed by the gifted class.

It is a simple adaptation, and well worth the additional monitoring and coaching, Tim says. "The students practice research skills, communication skills, and most keep their notebooks in better shape. They are proud of what they see hanging in the hallway." ■

Who's Park Is This?

"What do you think you'll find in the park?" Bernice asked her 5- and 6-year-old students. "Birds!" shouted an enthusiastic girl. "Squirrels!" responded an eager, red-haired boy next to her. Bernice's class was charged up for their field trip to Central Park—in search of wildlife in the middle of New York City!

But when they arrived at the park that April morning, what did they find? GARBAGE!

Level

– Lower Elementary

Story Focus

– Locating Instructional Resources

"This is yucky," said one student.

"It smells," chimed another.

"Well, who do you think made this mess?," Bernice asked the class.

"People," they responded.

"And who makes trash?"

"People."

"And are we people?"

"YES."

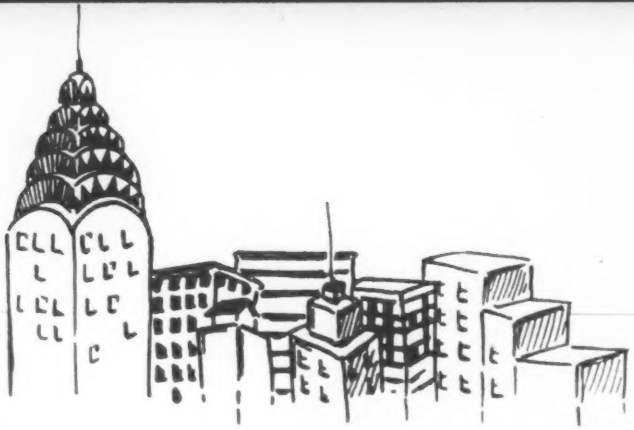
"And whose park is this?"

Hesitation… "Ummmm…"

Bernice Hauser
Horace Mann-Barnard School
231 W 246th St.
Bronx, New York 10471

And so began Bernice Hauser's garbage unit with her students at Horace Mann– Barnard School in the Bronx. Later, Bernice led the children back to Central Park, where they donned plastic bags like gloves and cleaned up the trash they found on their first visit: tissues, gum wrappers, cigarette butts, paper, cans, bottles and more. "Where does your trash go?" Bernice asked the busy students. "In the waste basket," came the response. "And what happens to it after that?" Student shrugs all around: "It just goes away… "

Back at school, a guest speaker from the NYC Department of Sanitation helped the students classify the trash. The students drew a "kids-eye view" map of Central Park on a long roll of butcher paper and glued bits of the garbage onto the map.



Bernice asked students to think back to their visits to the park and the map that they had just made. She asked them to imagine what they would include in the ideal kid's park. After a slight pause, there was a flurry of raised hands. The students came up with a wonderful assortment of design ideas, including a goldfish pond, lots of benches and other places to sit, numerous winding paths, a miniature zoo, a playground where walls could be assembled and then torn down, and even separate play areas for younger and older kids. The class topped off this exercise by building a scale model of their ideal park—it was, of course, a park without trash.

"Where does your trash go?" Bernice asked the busy students. **"In the waste basket,"** came the response. **"And what happens to it after that?"** Student shrugs all around: **"It just goes away..."**

In another lesson, students were asked to keep track of one week of classroom garbage. The trash was kept in a large bag. At the end of the week, the whole class gathered around the full sack. They weighed it and took turns feeling the contents through the plastic. The bag was then opened. Bernice had plans for this garbage.

The garbage was put to many creative uses. Some garbage went into the students' growing Garbage Museum, displaying the kinds of waste found in the classroom and around the school. Other pieces were taken by students and used to make small presents for their parents. Some students separated out the paper and made new paper. One group of students made a set of chairs out of empty soda cans. Another enterprising group built models of the World Trade Center's Twin Towers out of empty juice boxes. ■

Spilled Oil Spreads Science

When the Exxon Valdez spewed raw crude into the Prince William Sound, Gary Holsten and several other teachers in the Mat-su Valley recognized an opportunity amidst the tragedy. Over coffee in Gary's kitchen they hatched a plan to involve several students in a study of the impact of the oil and the oil clean-up process on intertidal animals.

Level

- Middle School

Story Focus

- Locating Instructional Resources
- Networking With Other Educators
- Locating Funding Grantwriting

With financial support from the Alaska Sea Grant program, Gary took five students from the regional middle school gifted and talented program to three sites in the Sound. The high profile of the spill meant wide-spread publicity for Gary and his students. As a result, other teachers expressed interest in teaming up with Gary, and plans were made for a larger follow-up study.

The following spring, Gary and fifteen students traveled to Juneau to discuss their test designs with marine biologists at the National Oceanic and Atmospheric Administration, NOAA. Even though three decades divided their ages, the students and scientists amazed each other with the quality of the discussion. That interaction defined the project for the next three years.

"An important aspect of the program was that students made critical decisions affecting the program," Gary explains. "They made decisions about test sites, they defined research questions, they involved other students from Native schools and from Massachusetts, and they did the work. I merely provided guidance from time to time, helped with housing arrangements, and cut some of the red tape."

Gary Holsten
HC03, Box 8090
Palmer, Alaska 99645

By the third year their beach transect procedure was well enough established that their elegantly simple studies were producing valuable data. "The students were surprised to discover that 80 years of logging and shipping activity can devastate the intertidal community more severely than the Exxon spill," Gary explains.

The project was a wonderful learning experience for Gary's students. "Over the course of the project the students learned not only about science and the environment, but about the real world too." ■

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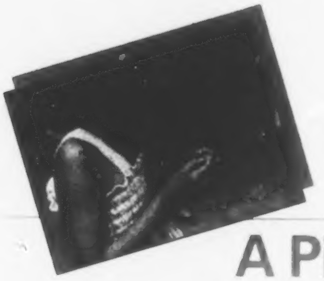


A Picture Tells a Thousand Stories

Level
- Elementary

Story Focus
- Locating Instructional Resources

Some people wouldn't consider reading picture books to be environmental education. But Susie Williams believes it can be.

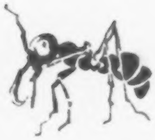
Susie teaches at Wheeler School, a private nursery-through-12th- grade school in Providence, Rhode Island. "The main thing is that we allow as many students as possible to feel their connectedness to all living things, and that this begin at an early age. At the primary school level, if I can give each student some respect for other living things, I feel successful. And this will help prepare them to learn other, more detailed knowledge later in their academic life," she says.

Susie is a "special subject" teacher at Wheeler, which means that she travels from room to room. She integrates science, literature, environmental education and art by developing students' animal classification skills, questioning abilities, and systems of value. "To teach the children about nature, I recently added picture books to my unit on live animals," Susie says. "I think they are a great way to address the values that are such an important part of environmental education without being preachy. They also allow me to combine science and good literature. Once a week I bring in a live animal and supplement it with a story about that animal. For example, "*The Salamander Room*" would supplement live salamanders.

"I've brought in worms, snakes, crickets, crayfish and chickens. I usually ask the kids to discuss the story about the animal and perhaps make an accurate drawing or careful observations. To teach the value of living things is difficult in an urban setting like this. It's easier and more lasting if one can instill this attitude through the students' interaction with live animals."

Susie Williams
Wheeler School
216 Hope Street
Providence, Rhode Island 02906

Formerly the director of a nature center, Susie has a long background in environmental education. She stresses the importance of knowledge and disbanding stereotypes. "One of my greatest triumphs is when some little girl enters my classroom with the uninformed position that 'worms are gross' and leaves with some idea of the purpose of worms in a natural ecosystem." She pauses in thought. "No, that sounds more complicated than it really needs to be. I'm happy when a child leaves my class fascinated by the interesting adaptations of even a lowly worm."



With that, she pulls a stack of paper out of her backpack. "Take a look at these. These are some of the students' drawings of the worms I brought in today," she says.

> "I'm happy when a child **leaves my class fascinated** by the interesting adaptations of even a lowly worm."

At first glance, the thick pencil lines on manila paper of the drawing look simple and awkward. On closer inspection, there is surprising sophistication. The drawing shows a "front" and a "tail," an egg sack and bristles that hold the worm in its hole. There is also a diagram showing the undulating movement of the earthworm, showing some knowledge of how a worm's body is constructed, and how it moves.

Susie puts away the drawings and gets up to leave. "Really, I believe that there is some ultimate importance to maintaining lines of communication between young children and the natural world, especially in an urban setting. Kids start out with an innate love and empathy for other creatures. It is integral to later environmental education to keep that love, or sense of connectedness, alive in children, so that they are open to receiving more complicated knowledge as they grow older." ■

The Energy Patrol Strikes

The Energy Patrol at Kimbark Elementary School doesn't just study the environment, it works on it.

Every morning, these fifth-graders check the kilowatt counter, a digital meter developed for the school by the Southern California Edison Company. They update charts to calculate how much energy was consumed. At the end of morning announcements, the Energy Patrol gives students a daily tip on how to conserve energy. The students write the text themselves.

Level
- Upper Elementary

Story Focus
- Enlisting Community Support
- Locating Instructional Resources

Kimbark is an environmental education magnet school, recognized as one of 10 exemplary schools nationwide by the National Science Foundation. Each grade has an environmental theme, and each year, fifth-graders work on energy conservation projects. Bonnie Trusler, the environmental education resource person at the school, describes the fifth-graders' most successful project, The Reminder. Students wrote up a school-wide notice that said, "If you leave the lights on in your classroom during recess or lunch hour, you'll return to find the room dark, and there will be a student-designed notice next to the switch plate, which admonishes: OOPS! You forgot to turn off your lights!"

In one year of operation, the kids of Energy Patrol helped reduce consumption of electricity at Kimbark by about 25 percent, saving the school thousands of dollars. One student helped her mother, a worker at the local post office, set up an Energy Patrol at her worksite.

Bonnie Trusler
Kimbark Elementary School
18021 Kenwood Ave.
San Bernardino, California 92407

In addition to the Energy Patrol, the students are working to organize an annual weeklong energy fair. During the fair, fifth-graders will teach younger students about energy conservation. The goal is to foster conservation at home, and each of the younger students will receive an energy workbook to complete with their families. Parents will sign off when the workbook is completed, and back at school the Energy Patrol will award conservation "merit badges" to their environmental proteges.

Although Bonnie gives the Energy Patrol guidance, it's up to them to think up and develop ideas. Although Bonnie says it takes more time to do things this way, she says it's well worth the effort because the ideas are theirs, and so are the results. "Helping kids know they can make a difference" is one of Bonnie's main goals. ■

The Greening of Dania

Level
- Upper Elementary

Story Focus
- Enlisting Administrative Support
- Enlisting Community Support
- Locating Instructional Resources
- Locating Funding/Fundraising

When Mary Jo Terminello began teaching third grade at Dania Elementary School in southern Florida, the campus was a virtual desert. Bereft of topsoil, with few trees or shrubs and no budget for landscaping, the school might as well have been in a logged-over rainforest or Sub-Saharan Africa. Undaunted, Mary Jo turned her students into a "baggie brigade," sending them home with plastic bags for them to fill with earth. The children dumped the soil into planters in Terminello's classroom, which is where the greening of the school began.

Several years later, in 1989, the program expanded to cover the entire school. With every bag they brought, the students put their names on a paper leaf that they hung on a "tree" in the art room. Sack by sack, each class filled a concrete planter with soil. When they needed money for seedlings, Mary Jo's students made terrariums out of two-liter soda bottles and Christmas decorations out of palms, and sold them to raise money. During one school year alone, 600 plants, and 60 trees and shrubs, were planted as a result of the program.

Before long, the students—and even Mary Jo herself—found their deeds guiding their thoughts, she says. Once they started to see that their actions could really make a difference, they felt a greater responsibility to the environment and branched out into other ecological endeavors. They brought their plastic to school for recycling, and got a picnic table—made from the same recycled plastic—from the company that collects it. They teamed up with the local high school to reprocess telephone books. Students took to letter-writing, cable-TV appearances and city hall meetings to press the local government to start a city-wide recycling program.

Ultimately, the students distilled their loyalty to the environment into a pledge they recite every morning after the Pledge of Allegiance:

> ***" We of Dania elementary, pledge to take good care of our water, space, air and land. We want to help the Earth by planting flowers and trees. The environment needs our help, so we won't pollute and we won't litter. We pledge to take good care, because we want our children and ourselves to grow up in a clean world."***

This rising tide of environmental action seems to be having an effect. Mary Jo tells of parents who come to confer with her. They say, "Oh, so you're the teacher who is responsible for my children telling me at the store 'Don't buy that, mommy,' or 'Recycle that, mommy!'" ■

Mary J Terminello
Dania Elementary School
300 S.E. Second Ave.
Dania, Florida 33004

Mangrove Monitor Madness

"Come on over here." Jerri motioned us towards the center of a very large room filled with all kinds of noises, including several different bird calls. We could also see and hear a cascade of water, and sure enough in the center of the room was an indoor pond, complete with a fountain, a waterfall, rocks, vegetation and sand beach. "The kids worked on this habitat," she says. "They research and build habitats for animals. This one is designed for the caiman, a type of small alligator. Right now, there're tadpoles in there. Do you see them?" she asks.

Level

- Middle School

Story Focus

- Enlisting Administrative Support
- Enlisting Community Support
- Networking With Other Educators
- Locating Funding: Grantwriting

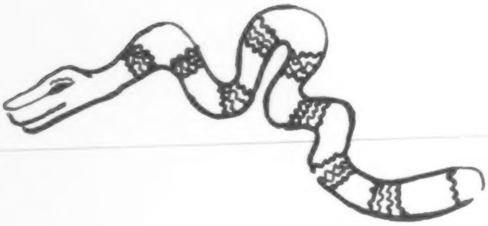
As we looked, we could see the tadpoles. A few were well on their way to becoming frogs. "It's really exciting," Jerri says. "Most kids never see the transformation of tadpoles to frogs or caterpillars to butterflies. Outside we also have a butterfly garden. We have an aviary out there, too, and we're building a greenhouse. It's not that we have any great overall plan here. It's just what we're doing and it keeps growing."

They now have sixty animals in the lab. "We have a beehive, a squirrel, raccoons, hamsters, an albino ferret. We have snakes, lizards, turtles, an iguana, prairie dogs, rabbits, a chinchilla. A chinchilla is a type of South American rodent," she explains. "You might have heard of chinchilla fur, used for coats. The students think they're really cute."

Jerri Kelly
Milam Intermediate School
720 West Jefferson St.
Tupelo, Mississippi 38801

"The kids do all the feeding around here, but only the brave ones will feed our mangrove monitor," Jerri continues. "It's a two-and-a-half foot lizard. He lives in a 75-gallon aquarium and the kids flock towards him. He eats six white rats a week, and many children don't understand why we need to feed him these. This of course is a nice occasion to explain the food chain." Jerri chuckles and adds,"I also ask them what they eat, and we talk about the cows and chickens we all eat for dinner. It's important that they see where they stand in the food chain, too."

The seeds for this lab began several years ago, when Jerri, who was then a language arts teacher, brought an aquarium, a hamster and a bird into her class. "I was amazed," she explains. "It had such a motivating effect on the children. They calmed down and got to work, just so they could have time to hold and look at the animals. Kids love the opportunity to be with animals." Jerri would occasionally buy another animal and then people started to donate them. "It just kept growing and we brought in as many animals as possible for our small classroom. Kids from the entire school were eager to look at the animals. 'Ms. Kelly,' they were constantly asking, 'can we come over to your room'?"



"Finally, three years ago, the school administration let me expand into an outdoor space and asked me to teach science. That was at King School. We built a beautiful outdoor classroom there, with a small pond, windmill, bird feeders, benches and a rock garden. It was a lovely space," Jerri says.

But the big change came last year, when Jerri's sixth-grade class moved into a new building. The building, the old junior high school, has a lot more space. Dr. Mike Walters, the Superintendent of Tupelo, Mississippi, Public Schools, had requested that Jerri set up an animal lab for the whole school. Jerri eagerly began the project. They gave her an area that had been two adjacent industrial shops and knocked a hole in the separating wall for a door. Now one side is Jerry's classroom and the other is the animal lab. It took all summer and many nights this fall to get it all set up. Monetary support came from the Tupelo Association for Excellence in Education, the Lee County Soil and Water Conservation District, local merchants, the principal and the maintenance staff.

> "I also ask them what they eat, and **we talk about the** cows and chickens we all eat for dinner. It's important that they see where they stand in the **food chain,** too."

All the teachers at Milam Intermediate School are encouraged to use the lab. Naturally, it fits with science classes, but English teachers use it for descriptive writing exercises and even the art teacher has a project designed where students create banners showing the habitat of their favorite animal. Not only does every child in the school visit the lab, but several other schools visit on a weekly basis. Some teachers have designed units around the lab, and when students visit, they rotate through the four stations: video center, laser disc/listening center, indoor animal space and outdoor animal space.

"The whole process has been amazing," Jerri says. "And it's changed my philosophy of teaching. Kids in my classes now experience hands-on learning. They feed, clean, hold animals, write down their observations, research in the library, visit the listening or video center in the lab, and it seems to meet the needs of every child.

"Further, you just can't imagine what a joy it is to teach when you see students' eyes light up and you see so many smiles." ■

Big Sky Country Expeditions

Most parents of Sheridan Elementary school students are farmers or talc miners. A few are loggers. And even though Sheridan, Montana, is but a few hours from Yellowstone National Park, few tourists travel through this valley.

"To say the word 'environment' means 'environmentalist' to most people around here," says sixth-grade teacher David Marsh. "And that means no logging, no mining, and too much wilderness. I wouldn't get very far if that's what they thought environmental education was all about. But I try to help kids understand that everybody has to have a little bit of environmentalist in them to take care of what we have around us. That's true for loggers and ranchers, too."

Level
- Middle School

Story Focus
- Enlisting Community Support
- Locating Instructional Resources
- Building Skills: Workshops, Courses, Inservice
- Networking With Other Educators

Taking care of what we have and enjoying our environment is the theme of David's fourth-quarter science program. It's divided into units on local conservation and utilization of resources.

"It is important to start our study with the orienteering unit and a recreational aspect of our environment," says David, who takes students trap shooting and fly casting after they study gun and water safety. "Enjoying the environment is one reason to keep it. Some youngsters return to these sports for a lifetime of enjoyment."

David Marsh
Sheridan Elementary
P.O. Box 586
Sheridan, Montana 59749

Guest speakers from the Fish and Game Commission spend time with the students. Talks include a history of game management, the return of the buffalo, boating and fish research. After a unit that includes groundwater, stream nutrients and aquatic habitats, a field trip takes students to shock fish, weigh them, age them and take scale samples.

Other speakers are provided by the Soil Conservation Service and US Forest Service. This outside support is critical to the success of David's program.

Between guest speakers, readings and field trips, David uses about 25 Project WILD activities to reinforce concepts, teach about life cycle strategies and nave fun. These short activities work well in combination and help him design a series of interactive lessons. David has used Project WILD for many years and became a facilitator to help introduce other teachers to the materials. The school board supported his work on the project even when it meant missing a school day.

Sheridan has its share of environmental problems. Fertilizers from farms can contaminate the river, and a clear-cut logging operation upstream sometimes produces a heavy sediment load. David leads class discussions on these topics. "The discussions are really animated since the kid's families are integrally involved with one aspect of the environment or another," recalls David.

But David believes controversy breeds more discussion. Most of his students aren't fanatical and are willing, maybe even anxious, to find a compromise. "When we finish a particular topic," David says, "it's easy to see that the only solution is to strike a happy medium, so that everyone can prosper." ■

Empowering Emily

Level
– Middle School

Story Focus
– Building Skills
Workshops, Courses, Inservice
– Locating Funding
Grantwriting

On a whim, Karen Kenna decided to spend part of the money she received for a hands-on math and science grant to attend an Investigation and Evaluation of Environmental Issues and Actions workshop.

The very next fall, she started applying her new teaching techniques in class. Karen and her sixth-grade students built an in-class reference file on the environment. They built landfill and compost columns in the room. They went on field trips to recycling stations and landfills. They even picked apart their lunches, analyzing where things came from and how much is wasted.

"I began to look at myself as more of a facilitator of resources and much less as a source of information," says Karen, who was first motivated to attend the workshop because of her frustration about the lack of environmental material in textbooks. "I mean… come on… here I was a new teacher enthusiastic about doing environmental education, and I could have covered all the information presented in the assigned textbook about the environment in a single day. The IEEIA program totally changed my perspective, and it's had a major impact on the way that I teach." IEEIA runs workshops to teach the skills and knowledge needed to implement a hands-on environmental education program.

Karen pauses for a moment and pulls out a frayed photograph of her sixth-grade class. She points to a tiny blonde in the second row. "That's Emily. When the class was assigned a research project involving a paper and a presentation, Emily snatched up the topic of animal rights from some information which I'd brought in, and really did an incredible job. She wrote letters to Colgate-Palmolive, Revlon, L'Oreal and Ralston Purina asking them about their animal testing policies, receiving responses from all of them. She also received information from an animal rights activist group, complete with graphic pictures showing the inhumane treatment of animals.

"What impressed both the class and myself during the presentation was that she not only offered information, she also had an action plan ready. She had prepared a list of companies that test their products on animals, asking those in the classroom to boycott those products. Her final portfolio consisted of her formal research paper, a list of primary and secondary sources, and a bibliography. An amazing level of interest and commitment from someone so young."

Karen Kenna
Thoreau Middle School
2505 Cedar Lane
Vienna, Virginia 22180

After attending that first workshop, Karen has served as a facilitator for IEEIA for two years and also for Kraft General Foods' "Solid Thinking About Solid Wastes" educational program, which is modeled after IEEIA. "I've thought about moving on to teaching at the university level, but I get so much out of teaching my younger students. I really think that we grossly underestimate the power of kids this age," Karen says. "I mean, just look at Emily."

"I began to look at myself as more of a **facilitator of resources** and much less as a source of information."

Her present class is busy learning about local environmental issues, including the Chesapeake Bay's problems. "We've recently built a model of an estuarine ecosystem in the classroom. It's very valuable to break down and talk about the environment that surrounds these kids. It helps students become methodical thinkers and develop problem-solving skills that are both transferable and lifelong. I like to believe that students walk out of my classroom with a sense of hope and purpose, that all is not gloom and doom, and that they themselves are the keys to the equation." ■

Things That Aren't Supposed to Be There

Vicki Rich uses her school's five-acre Wooster, Ohio grounds as an environmental class room. Outside, she leads her third-grade students on a search for "things that aren't supposed to be there."

In the school's playing fields, parking lots and woods, they collect paper, plastic and other trash. One year, a student found a rusty, old wrench. Another group discovered a sharp chunk of metal jutting up from the ground. Working together to dig it up, students and teachers discovered it was an engine. The day after this treasure hunt, Vicki invites a community recycling program representative to discuss with her class the difference between recyclable and non–recyclable materials.

Level
- Upper Elementary

Story Focus
- Enlisting Community Support
- Locating Instructional Resources

Before sending away all those "things that aren't supposed to be there," Vicki leads an art project. The students use their found objects to build sculptures. "They're usually pretty abstract," says Vicki. Once appropriately admired by the other classes in the school, the artwork is dismantled and the objects divided into appropriate categories: natural objects go back to the woods, recyclables go to the recycling center. Trash is disposed of properly. The student who found the wrench managed to trade it for a new one at the hardware store.

Vicki Rich
Wooster Township Elementary School
1071 Dover Road
Wooster, Ohio 44691

Vicki's hunt is just one of many environmental activities she leads during the school year. Years ago, she started small, adding environmental words to her language arts lessons, and reading environmental fables like Bill Peet's "The Wump World." One year, she asked students to write themes on the topic of 'How I See Today's World, and How I Would Change It.' Going to the library, looking up organizations that offer environmental curricula and writing for information generated a wealth of material. So much, she had no trouble creating a one-week, multidisciplinary environmental unit. Now Vicki uses a variety of resources and weaves environmental themes throughout her curriculum. "I wanted to add ideas that my students would find relevant and which would supplement the textbook," she says.

Vicki's unit meets all district standards. She addresses the environment while meeting objectives in art, math, science and language arts. Each year, she changes some elements, keeping activities that work particularly well. She has so much material and so many ideas, she says she could teach an entirely different unit each year. All it took to get started was an interest in going beyond the textbook. ■

Unit 3
Taking the Next Step

Taking the Next Step

Jerri Kelly's *("Mangrove Monitor Madness")* environmental education efforts began a few years ago when she brought an aquarium, a hamster and a bird into her sixth-grade language arts class. Last year, at the request of the school superintendent, Jerri expanded her animal lab for use by the entire school. It now includes nearly 60 animals, including an iguana, a chinchilla and a 2 1/2-foot lizard.

Although the next step in your EE effort may not be as dramatic as Jerri's, improving and expanding your EE lesson, unit or program is likely to involve additional steps to those mentioned in Unit 2. Three of these steps are covered in this unit.

The first, "Networking," suggests ways to meet other environmental educators. Other teachers are often the best source for information pertaining to resources and programs available in your area. Networking is a way for you to share your efforts. The "Grantwriting" section details the process of researching sources of grants and applying for them. "A Pat on the Back" lists awards, scholarships and stipends given out each year to deserving environmental educators.

Networking: Meeting Other Environmental Educators

Other educators are an important resource to consider as you build your EE lesson, unit or program. Other educators can help you locate curriculum materials, overcome bureaucratic hurdles, and find funding, workshops and experts in your area. You may also become a resource for other educators trying to bring EE into their classrooms.

Professional Organizations for Environmental Educators

Professional organizations for environmental educators often exist at the state and local level. Refer to the resource indices at the back of this guide for the address of the professional organization(s) in your state. In addition, you can locate your state association for environmental education or a regional network of environmental educators by contacting the North American Association for Environmental Education, your Regional EPA Office or the Department of Education EE specialist in your state. Examples of the activities that state EE organizations are involved in include:

Ohio Conservation and
Outdoor Education Association
397 West Myrtle Avenue
Newark, OH 43055

— Every spring members of the **Ohio Conservation and Outdoor Education Association** gather for a conference, sharing new ideas, renewing friendships and welcoming new teachers. Skill-building workshops, tables loaded with handouts, freebies and resources to buy, and field trips fill the weekend agenda. A newsletter keeps the members updated throughout the year and offers news from across the state.

Texas Environmental
Education Advisory Committee
Attn: Irene Pickhardt
Texas Education Agency
1701 North Congress Ave.
Austin, TX 78701
(512) 463-9556

— In Texas, an **EE Advisory Committee** was created from business, industry, government representatives and teachers to help coordinate EE efforts throughout the state. They have spearheaded the dissemination of a helpful directory of outdoor education sites. One of the group's members, the Lower Colorado River Authority, is selling copies. The committee is also identifying and reviewing EE teacher training programs already being offered in different regions within the state. Those programs meeting state criteria will be certified as state EE sites, and the committee will raise funds to help teachers attend.

NAAEE
Membership and Publications:
PO Box 400
Troy, OH 45373
(513) 676-2514

Washington Address:
1255 23rd Street, NW, Suite 100
Washington DC 20037
(202) 467-8753

Several national organizations include:

— **The North American Association for Environmental Education** (NAAEE) is the largest organization of professional environmental educators in the world. The NAAEE offers conferences, a newsletter and other publications, providing the opportunity for educators to support and learn from each other.

Global Network of Environmental
Education Centers
7010 Little River Turnpike
Suite 290
Annandale, VA 22003
(703) 750-6401
Fax (703) 750-6506

— **The Global Network of Environmental Education Centers** is a non-profit organization that facilitates information and resource exchange between EE centers to help them improve their educational efforts.

Alliance for Environmental
Education, Inc.
51 Main St.
P.O. Box 368
The Plains, VA 22171
(703) 253-5812
Fax (703) 253-5811
EcoNet: 'alliance'

— **The Alliance for Environmental Education** is a coalition of nearly 300 professional, business, health, labor, government agency, education, environmental and other non-profit organizations that share a commitment to furthering EE efforts worldwide.

National Science Teachers Association
1840 Wilson Blvd.
Arlington, VA 2201-3000
(703) 243-7100

— **The National Science Teachers Association** is the largest organization of science teachers in the world. The NSTA offers a large environment/ecology section at each of its four yearly conferences, four journals, a student magazine, several newsletters, awards, competitions, projects, and publications for a wide range of subject and grade level interests.

There are also networks for specific issues or subject areas, such as:

GREEN
721 East Huron
Ann Arbor, MI 48104
(313) 761-8142

— **The Global Rivers Environmental Education Network** (GREEN). GREEN acts as a clearinghouse and network for individuals, school and community groups, and other organizations interested in water quality issues.

Networks for Students

You may be interested in having your students network with other students interested in environmental issues. The following is a very brief listing of some environmental groups by and for young people:

Clinton Hill's Kids for Saving Earth
620 Mendelssohn, Suite 133
Golden Valley, MN 55427
(800) 44E-ARTH

Clinton Hill's Kids for Saving Earth (KSE) is an independent, non-profit organization whose mission is to educate and empower children of all ages worldwide to unite with friends and take positive, peaceful action to help protect Earth's environment. KSE kids are involved in countless projects: recycling, adopting endangered animals, alerting others with letters, signs, plays, and petitions. The only requirement for membership is to recite the KSE promise, and pledge to try to help the Earth.

Kids For A Clean Environment
P.O. Box 158254
Nashville, TN 37215
(800) 952-3223

Kids For A Clean Environment is a non-profit childrens' organization that provides free membership to children and teachers. Included with the membership is a membership guide: *Our World, Our Future: A Kids Guide to Kids For A Clean Environment* and a subscription to the bimonthly newsletter *Kids F.A.C.E. Illustrated.* Materials focus on environmental topics and offer projects that can be performed at home or at school.

Student Environmental
Action Coalition
P.O. Box 1168
Chapel Hill, NC 27514-1168
(919) 967-4600
Toll Free: (800) 700-SEAC

The Student Environmental Action Coalition (SEAC) is a grassroots coalition of over 2,000 high school and college student and youth environmental groups, working to protect the planet. Among other things, SEAC runs a National Clearinghouse of information on environmental and social justice issues and publishes a monthly magazine which presents a comprehensive picture of the student environmental movement.

Grantwriting — Where to Look

Grantwriting can be an intimidating and time-consuming process. But it can also lead to solid financial support for your EE efforts. When Aline Novak *("One Fish, Two Fish, Red Fish, School Fish")* wanted to increase the scale of an experiment her students were conducting on the effects of an herbicide on trout, she looked to outside funding sources. With grants from the Chesapeake Bay Trust and the Maryland Department of Natural Resources' Tidewater Administration she was able to buy an old bulk tank, new water pumps and water-quality testing equipment. Debra Mullinnex *("The Sky's the Limit")* wrote a thousand dollar grant to buy seeds, garden tools and a strong fence for her garden project. This section includes information on several funding sources and tips for writing convincing proposals.

Non-Profit Foundations

According to a 1990 report by the Environmental Data Research Group, charitable, non-profit foundations gave well over $30 million to support EE initiatives. These foundations range from national, multi-faceted organizations to foundations whose activities are restricted both topically and geographically. The most direct way to investigate foundations is to call and request the foundation's yearly report or an explanation of their current funding priorities.

Regional or local community foundations are the best place to begin your search. Regional or local foundations fund a variety of projects aimed at improving the quality of life in a particular area, which in many cases includes environmental education. The **El Paso Community Foundation, the Denver Foundation** and the **Northwest Area Foundation** are examples of organizations that provide funding for projects in specified metropolitan areas. The **New Hampshire Charitable Foundation** is an example of a foundation that provides funding for projects in a specific state. In seeking information about similar groups in your area, one place to turn is your Chamber of Commerce. Library research may also identify local foundations.

The Denver Foundation
455 Sherman Street
Suite 220
Denver, CO 80203
(303) 778-7587

Northwest Area Foundation
Suite E-1201
First National Bank
332 Minnesota Street
St. Paul, MN 55101-1373
(612) 224-9635

The New Hampshire Charitable Foundation
37 Pleasant Street
P.O. Box 1335
Concord, NH 03302
(603) 225-6641

Large, national philanthropic foundations are also aware of the growing need for EE. The competition for grants from national foundations, however, is extremely keen. In seeking information about national foundations, one place to turn is the **Environmental Grantmakers Association.** This association, made up of some of the largest foundations in the country, can provide general information on grants available for EE initiatives. The **Environmental Data Research Institute's** *Environmental Grantmaking Foundations 1993* publication lists geographic data, application deadlines, emphasis and limitations of funding, and names of personnel for 417 foundations.

Environmental Grantmakers Association
1290 Avenue of the Americas
Suite 3450
New York, NY 10104
(212) 373-4260
Fax (212) 315-0996

Environmental Data Research Institute
1655 Elmwood Avenue, Suite 225
Rochester, NY 14620
(716) 473-3090
Toll Free: (800) 724-1857
Fax (716) 473-0968

Library research may also help identify national foundations. One useful resource at the library is the *Chronicle of Philanthropy: The Newspaper of the Non-profit World.* It provides important information about the funding priorities of many non-profit foundations.

Below are a few examples illustrating the variety of foundations that exist nationally.

— **The National Environmental Education and Training Foundation** is a Congressionally chartered non-profit charitable foundation dedicated to fostering public-private partnerships in support of environmental education and training programs nationwide. The Foundation is able to combine public sector resources with private sector funds in support of EE. In October 1992, the Foundation awarded more than $1 million in grants for EE projects.

NEETF
915 Fifteenth Street, N.W.
Suite 200
Washington, DC 20005
(202) 628-8200
Fax (202) 628-8204

National Fish and Wildlife Foundation
1120 Connecticut Avenue, N.W.
Suite 900
Washington, D.C. 20036
(202) 857-0166

— **The National Fish and Wildlife Foundation,** like the National Environmental Education and Training Foundation, is a Congressionally chartered, non-profit charitable foundation that focuses a substantial amount of its annual grants on programs supporting environmental education in wildlife and natural resources issues.

The John D. and Catherine T. MacArther Foundation
140 South Dearborn Street,
Suite 1100
Chicago, IL 60603
(312) 726-8000

— **The John D. and Catherine T. MacArthur Foundation,** a large, national charitable foundation, was identified by Environmental Data Research Group as the largest funding source of EE projects in 1990. They were estimated to have given out more than $5.5 million to EE projects.

PEW Charitable Trusts
One Commerce Square
2005 Market Street, Suite 1700
Philadelphia, PA 19103-7017
(215) 575-9050

— **The PEW Charitable Trusts** is another large, national charitable foundation with interests in environmental education. In 1990, PEW funded 22 environmental education projects, totaling more than $1 million.

The George Gund Foundation
1845 Guildhall Building
45 Prospect Avenue West
Cleveland, OH 44115
(216) 241-3114

— **The George Gund Foundation** funds national projects, but like most foundations, it has a focus on a particular geographic area. In Gund's case, that focus is Cleveland, Ohio. In 1991, they provided over $920,000 for EE projects.

The Corporate Sector

National and multinational corporations can be a valuable source of support. Large corporations are often willing to support innovative EE programs. Corporate support is not limited to national projects. Sharon Ferriss' students *("Too Much Stuff")* approached the local Wal-Mart and received financial assistance to start a school recycling program. Charlotte Pine *("We Never Give Up")* convinced the local Target store to sponsor her students' efforts to start a school carpooling program.

Large corporations often have foundations that oversee their charitable activities. The local branch of these organizations is the best place to receive information concerning their specific proposal requirements. It is not uncommon, for example, for local branches of banks to administer community grant programs. This is especially true for locally-owned banks.

While approaching these large corporations might seem a little intimidating, you should not underestimate either their desire to become involved in projects that show their concern for the local community, or the depth of their pockets. A detailed proposal is necessary to inform potential supporters of both the goals you hope to accomplish and the program's time frame.

As Bonnie Trusler's students (*"The Energy Patrol Strikes!"*) have discovered, financial support is not the only assistance businesses can deliver. Local utility companies and universities are often willing to take an active role in lending their expertise. Engineers, lawyers and architects are just a few of the professions teachers can approach to get professional support for EE projects.

State Level

Approaches toward financing environmental education at the state level are diverse. In states such as Wisconsin, for example, programs are financed by allocations from the state treasury. The **Wisconsin Environmental Education Grants Program** funds EE curriculum development and staff training in environmental education in Wisconsin. In California, a portion of the revenue from the sale of specialized license plates goes into an account dedicated to funding environmental education projects. The **California Department of Education** has established a grants program to encourage implementation of EE projects at both the school- and district-level. The Iowa Department of Education administers the **Iowa Conservation Education Program** which funds the development and dissemination of EE curriculum materials and in-service teacher training.

Given the tight budgetary constraints, other states have developed creative financing approaches for environmental education. In Florida, for example, the **Environmental Education Foundation of Florida, Inc.** has been established to secure funding for EE programs in the state school system.

Your state's environmental education coordinator can provide information about the availability of similar funding possibilities in your state. See the resource indices at the back of this guide for the name and address of your state coordinator.

Wisconsin Environmental
Education Grants Program
P.O. Box 7841
Madison, WI 53707-7841
(608) 266-3155

California Department of Education
721 Capitol Mall
P.O. Box 944272
Sacramento, CA 94244-2720
(916) 657-5374

Iowa Conservation Education Program
Iowa Department of Education
Resource Enhancement and Protection-
Conservation Education Program Board
Dwayne Toomson
Grimes State Building Office
Des Moines, IA 50319
(515) 281-3146

Environmental Education
Foundation of Florida, Inc.
The Capitol, Suite LL06
Tallahassee, FL 32399-0001
(904) 488-5551

Federal Level

Under section 6 of the National Environmental Education Act (public law 101- 619) the Environmental Protection Agency is authorized to provide grants up to $250,000 to support projects to "design, demonstrate, or disseminate practices, methods, or techniques related to environmental education and training."

For information on how to apply for grants over $25,000:

Environmental Protection Agency (1707)
Environmental Education Division (grants)
401 M Street SW
Washington, DC 20460
(202) 260-3335

For information on how to apply for grants under or equal to $25,000:

Contact your Regional EPA Environmental Education Coordinator (See the resource indices at the end of this guide for a list of addresses)

In 1992, under the Section 6 grants program, the EPA awarded $2.4 million from requests for more than $100 million. In 1993, the EPA awarded 261 grants worth $2.7 million. Of the selected grants, many went to programs at individual schools or school districts. These include a $5,000 grant to Petrolia School, Inc. (see Seth Zuckerman, *"Action for the Forest"*) to develop a curriculum to link science and social studies with an emphasis on environmental issues both local and global; a $5,000 grant to the Casa Grande Elementary School District in Casa Grande, Arizona, to develop an outdoor environmental education center, featuring hands-on activities, for ninety at-risk students; and a $4,650 grant to the Linn R-11 School in Linn, Missouri, to disseminate information concerning environmental problems using a student-operated public service FM radio station.

Department of Agriculture
Natural Resources and Environment
Environmental Coordination
Auditors Building
Fifth Floor SO
201 14th Street, SW
Washington, DC 20090-6090
(202) 720-7173

The U.S. Department of Agriculture *Natural Resource Education Program* provides grants to local schools, non-profit organizations, and others to work with state forestry agencies and national forests to teach about the environment.

How to Write an Effective Grant Proposal

There are several resources that may be helpful when writing your grant application. You may know a fellow teacher who has experience writing grant applications or your school may have an administrator assigned to this role. You may even know someone in your community with skills in this area: a friend, parent, or P.S.T.A. member.

There are also resources available outside of your immediate community. For example, the North American Association for Environmental Education, NAAEE, in cooperation with the U.S. Environmental Protection Agency has produced a 30-page document with tips, advice and resources to help you better target your fund raising efforts and write better proposals. *Grant Funding for Your Environmental Education Program: Strategies and Options* is available from NAAEE. Write to their Publications and Member Services Office for more information.

NAAEE
Publications and Membership
P.O. Box 400
Troy, OH 45373
(513) 676-2514

Although grant applications vary, at minimum, you will be asked for the following information:

— **Statement of how your project will meet the objectives of the grant program:** Explain how your project addresses the program's overall objectives.

— **Problem statement:** Explain the need your project addresses. Include an anecdote or story to support your problem statement and list any support your proposal has already gained, such as community or parental support.

- **Goals statement:** Describe the goals of your project. Tell how your initiative addresses the problem outlined in your problem statement.
- **Action plan:** Explain how you plan to achieve your goals. Include a timeline and a budget.
- **Evaluation method:** Describe how you will measure the success of your project.

When developing your proposal, it is important to remember who your audience is, what you need to convince them of, and why you need their support. In addition, it is extremely important to follow the directions included in the grant application. Faced with the daunting task of sorting through hundreds of applications, the first criteria reviewers often check for is whether the applicant followed the directions.

It is important to follow-up your application with a letter, phone call or personal visit. This conveys your commitment to the project. It may even be possible, particularly with local funding sources, to invite a representative of the organization to visit your school and observe your program.

If you receive funding, it is a good idea to send thank-you letters to all grantors. In addition, you will want to thank anyone who helped you win the grant. You may also be requested to write a follow-up report.

If you are not awarded a grant, you might want to ask grantors to explain their specific reasons for not funding your project. This is a good way to improve your grant application in the future.

A Pat On the Back: EE Awards, Scholarships and Stipends

When Charlotte Pine *("We Never Give Up")* first entertained the idea of giving her fifth-grade students the task of 'solving' the problem of air pollution in their county, never in her wildest dreams did she envision her students featured in a CBS special or participating in World Environment Day at the United Nations.

Many organizations and businessess–both nationally and locally–recognize the contribution of teachers and students to their communities. Some award certificates of appreciation, others provide scholarships, and others give cash prizes or stipends. Below are some award programs that pertain to EE efforts.

- Young people from all 50 states are invited annually to participate in the **President's Environmental Youth Awards.** The program is aimed at encouraging individuals, school classes, summer camps, public interest groups and youth organizations to promote environmental awareness and positive community involvement. The program has two components: The regional certificate program and the national awards competition. Application materials for the PEYA award are available from your EPA Regional Office. See the resource indices in this guide for that address. The EPA Environmental Education Division also administers the **National Environmental Education Awards** program. This award, given every two years, next in the Spring of 1995, honors individuals for their outstanding contributions to environmental education. Application materials may be requested from the U.S. EPA's Environmental Education Division in Washington, D.C.

—**The Amway Corporation's "Class Act" Environmental Challenge** for students grades 4-8 awards $5,000 cash prizes to each of ten schools nationwide. The awards honor outstanding enviornmental stewardship projects, campaigns or fundraisers. By encouraging and showcasing the environmental projects of students and their schools, Amway hopes to raise awareness among youth and give them an opportunuty to show that they can make a difference through individual and team efforts.

—**The Renew America** *Environmental Success Index* identifies programs around the nation, whether large or small, that effectively protect, restore or enhance the environment. Each year's winning programs receive the Robert Rodale Environmental Achievement Award. Renew America is a non-profit, clearinghouse for environmental solutions.

—**Chevron Corporation** awards **25 Chevron Conservation Awards** every year: 10 go to professionals, 10 to volunteers, and 5 to organizations or government agencies. Anyone—students or teachers—involved in natural resource conservation may apply for a $1000 award.

—**Seiko Youth Challenge** is a nationwide competition in which teams of two to four students in grades 9-12, guided by a faculty advisor, are asked to identify, investigate, analyze and propose a solution to a specific environmental problem facing their owncommunity.

—**The Presidential Awards for Excellence in Science and Mathematics Teaching (PAESMT),** identify outstanding teachers of science and mathematics K-12. Guidelines for nomination include ability to engage students in hands-on science and/or mathematics inquiry activities, and ability to generate excitement among students, colleagues, and parents about the uses of science and mathematics in everyday life.

—**The Eco-Educator Award** is given by the **"Firestone Firehawks"** to recognize teachers who demonstrate creative use of innovative, exploratory and hands-on methods to teach children about complex interrelationships between humans and their environment. The school, agency or community organization with which each winner is associated will be awarded a $1,000 stipend to be applied to EE programs.

U.S. Environmental Protection Agency
Environmental Education Division (1707)
401 M Street, SW
Washington, DC 20460
(202) 260-4962
or (202) 260-4965 "Class Act"

"Class Act"
Amway Creative Resources, Inc.
Grand Plaza Place
220 Lyon Street NW, Suite 567
Grand Rapids, MI 49503-2210
(616) 456-1500

Renew America
1400 Sixteenth Street, NW, Suite 710
Washington, DC 20036
(202) 232-2252

Chevron Conservation Awards Program
P.O. Box 7753
San Francisco, CA 94120-7753
(415) 894-2457

Seiko Youth Challenge
c/o DRB Communications
1234 Summer Street
Stamford, CT 06905
(800) 323-1550

Elementary PAESMT
National Science Teachers Association
1840 Wilson Blvd.
Arlington, VA 22201
(703) 243-7100

Secondary PAESMT
National Science Teachers Association
1840 Wilson Blvd.
Arlington, VA 22201
(703) 243-7100

Firestone Firehawks
Eco-Educator Award
209 7th Ave. N.
Nashville, TN 37219
(615) 780-3330

TAPESTRY/NSTA
1840 Wilson Boulevard
Arlington, VA 22201
(703) 243-7100

— **Toyota/National Science Teachers Association TAPESTRY Grants.** TAPESTRY is a teacher grant program that offers grants of up to $10,000 each to science teachers in grades 6-12 who propose innovative student projects in environmental and physical science.

Council for Basic Education
1319 F Street, N.W.
Suite 900
Washington, DC 20004-1152
(202) 347-4171

— **The Council for Basic Education** offers fellowships of up to $3800 for independent summer study in the humanities on a topic of choice which links the sciences and the humanities. The award is open to science and math teachers who have demonstrated the potential for successful independent study and who present outstanding study plans.

A Pledge and a Promise Environmental Awards
Education Department
Sea World
7007 Sea World Drive
Orlando, FL 32821
(407) 363-2389

— **The Anheuser-Busch Theme Parks "A Pledge and a Promise Environmental Awards 1994"** recognize outstanding efforts of school groups who have made lasting contributions to the environment. A total of thirteen awards are presented, including a grand award and a first, second and third place award in each of the following four categories: K-5, 6-8, 9-12, and college.

Final Thoughts

When Kendra Grove *("Handling Hurdles")* began supplementing her 10th-grade biology class with field trips, she could never have imagined she would eventually get her county bus driver's license to save her school money. She never dreamed that she would eventually form a 4-H club to get the extra insurance her trips required.

Gil and Marilyn Alexander *("The Big Stink")* could not have anticipated that their field trip with four students 10 years ago would grow into a program of 90 students per year and lead to the creation of a non-profit organization to take donations and write grant proposals.

Jerri Kelly *("Mangrove Monitor Madness")* never imagined that bringing an aquarium, a hamster and a bird into her language arts class would eventually lead to the creation of a butterfly garden, a green house and an all-school animal laboratory housing over 60 animals.

These examples illustrate the excitement that environmental education can generate among students, teachers, parents and school administrators. They also illustrate creative ways teachers have overcome obstacles in bringing environmental education into their classrooms.

Whether the EE activity, lesson, project, unit or curriculum you initiate grows like those of Gil, Marilyn and Jerri's, or leads to implementation challenges like those Kendra faced, you will discover that environmental education is exciting and full of challenges. Regardless of where environmental education in the classroom leads you and your students, you will find that your most exciting stories are those from when you were just "getting started."

We Never Give Up

When a mock televsion program, Earth Talk, reported that their county was not meeting federal clean air standards and that 70 percent of air pollution is due to car emissions, Charlotte Pine knew she was experiencing 'a teachable moment.'

"However, I never imagined the outcome of my question when I innocently asked the class, 'What can we do about this?'" she says.

Level

- Upper Elementary

Story Focus

- Enlisting Administrative Support
- Enlisting Community Support
- Locating Instructional Resources
- Locating Funding: Fundraising
- Networking With Other Educators

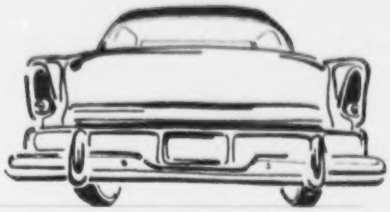
Students decided to focus on automobile pollution in a unit and Eco-Carpool '91, a schoolwide car pool program, was born. Fourth- and fifth-graders set to work designing a master plan and creating the forms necessary to set up car pools at the school. "I was amazed at how thorough the students were in their design of the forms," recalls Charlotte, who had never before been actively involved in environmental education. "They would think aloud: 'We have to be careful to consider the number of safe seats in each car, as well as the rider's location and schedule of availability.' They really dug their heels in and considered the problem from all angles."

The project fit Charlotte's theme for the year: "Let's Get Down to Earth: Earth Day Every Day." Students planned an aggressive advertising campaign consisting of three schoolwide contests: A Car Pool Slogan Contest, a Bumper Sticker Contest and a Poster Design Contest. Target stores, the group's key sponsor, presented ecology-oriented gifts to the contest winners and funded five hundred "Pollution Solution: Car Pool" bumper stickers. The school's P.T.O. contributed nine award ribbons. In addition, a special closed-circuit television feature, Eco-Babble, reported car-pool progress and the awarding of class car-pool participation certificates. To generate further interest in the environment among parents and teachers, junior representatives wrote articles for the school's monthly Nob Hill Newsletter.

Eco-Carpool '91 enrolled 79 participants from the school community, resulting in reduced air-pollution levels for the county and reduced traffic congestion at the school.

Charlotte Pine
Nob Hill Elementary
2100 Northwest 104 Avenue
Sunrise, Florida 33322

Recognizing a strong national interest in this project, the next year Charlotte and her students decided to develop a model car-pool program that could be easily replicated across the country. The first step was to evaluate the original project. Forms were carefully examined and revised. New ones were added. An Eco-Car Pool packet was written to make it easier to start up this program in other schools. The availability of this packet was publicized in "Renew America's Success Index," in "What Works: Air Pollution Solutions," compiled by the Environmental Exchange and in a teacher's manual, "Plan It For the Planet," currently distributed by Scholastic News, Inc., to 100,000 classrooms around the nation.



Awards rolled in. NBC's "Today Show" interviewed one student, while Children's Earth Fund selected another to help present a Children's State of the Union Address at the Washington Press Club. Three other students traveled with Charlotte to New York City to participate in World Environment Day at the United Nations. They were recognized as "Champion Defenders of the Earth" in a contest sponsored by environmental programs, Target and Kids for Saving Earth. A CBS special, "50 Simple Things Kids Can Do to Save the Earth," featured other students.

Charlotte Pine had never been actively involved in environmental education prior to serving as "guide on the side" to Eco-Carpool '91. However, the goals of environmental education fit neatly into her philosophy of teaching. "It's my responsibility to help them to identify and solve problems via the process of creative problem solving. That's what Eco-Carpool '91 was really all about. It was our solution to the problem of air pollution."

Clearly, the Florida Kids For Clean Air achieved their goal. In addition to gaining the attention of classrooms across the country, there are now 141 carpoolers at Nob Hill. This is a 36 percent increase over last year and a 78 percent increase from the first year of the program.

Charlotte attributes the group's success to the students' hard work. "Their motto is 'We Never Give Up,' and it shows," Charlotte says. "The kids learned that they can make a difference. I truly believe that helping them to achieve this sense of self-efficacy is an important part of their training to become leaders in the 21st century." ■

Eco-Carpool

Caring and sharing have always been our creed, to spread the eco-gospel is what we believe. Our goal to save the planet has been very strong, as Florida Kids for Clean Air, we've worked hard and long.

Using a variety of approaches has been our claim to fame, having more success than failure, we're ahead of the game. We stick with our projects through thick and through thin, with strong commitment and enthusiasm we usually win.

To clean up the air, we're "all systems go," as our school-wide car pool program continues to grow. Special thanks to EPA for being our motivating force, by identifying Florida's air pollution problem, you set us on course.

We'll be keeping our wheels spinning, always in the right direction, helping to move our planet toward environmental perfection.

The Big Stink

Take a group of high school freshman to a remote canyon reservoir for a week, ask them to work long hours in the hot sun with water-monitoring equipment, and you have trouble getting them to quit working long enough to sleep. Gil and Marilyn Alexander should know. They've been taking groups to Canyon Ferry Reservoir for years. The project began when students noticed the water "smelled rotten" after a long hot summer when algae were abundant.

Level
- High School

Story Focus
- Enlisting Community Support
- Locating Instructional Resources

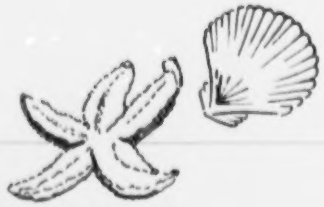
"We figured anything that stunk so bad was worth studying," said Gil, an earth science teacher at Helena High School. He and Marilyn, a chemistry teacher, struck upon the idea of an extended field trip with some students, and decided to fund it almost entirely out of their own pockets.

The first crew of students, four of them, camped on the riverbank of the major feeder streams to the Missouri River. Under Gil and Marilyn's guidance, they studied the geology and chemistry of the canyon and sampled the river system that feeds the reservoir. A week later, an algae bloom coincidentally became toxic and killed a number of cattle in the area. The project was highlighted on news stories about the incident, and the kids basked in the sudden attention.

Gil and Marilyn Alexander
Canyon Ferry Limnological Institute
7653 Canyon Ferry Road
Helena, Montana 59601

Over the course of a decade, the field trip has evolved into a residential field study which has grown from four students to 90. As the project's size has expanded, so have the responsibilities. No longer funded by Gil and Marilyn's checkbook, a 501(c)(3) non-profit corporation now takes donations to cover expenses. Grants support expanded projects, and the community has enthusiastically helped. The program provides water monitoring clinics for groups like Montana Clean Lakes Volunteer Monitors, Project WILD, and Project WET, and has established a computer workshop and information network, which allows other groups to tap into their information. The breadth of programs stretch from awareness clinics to full blown scientific investigations using a wide array of sophisticated instrumentation for data acquisition. They even look forward to an exchange program next year with Russian students, who will study Montana rivers while American students explore rivers flowing to the White Sea.

The exciting and challenging atmosphere brings new students into close contact with science, an experience that has had a lifelong impact for many. About 80 percent of the participating students have continued in science. One former student explains that after a long trail of changed majors in college, she's pleasantly surprised to find that she's doing what she loved as a ninth-grader: She's a water quality consultant in Colorado. ■



Handling Hurdles

By the time Rachel reached Kendra Grove's door, the sign-up sheet for the river clean-up had 50 names on it. With that many names, at least two busloads of students from Kendra's 11th-and 12th-grade marine biology classes would be going to clean up a river in Pensacola, Florida. Last month Rachel went with a busload of students to visit the local landfill.

Level
- High School

Story Focus
- Enlisting Administrative Support
- Locating Instructional Resources
- Locating Funding Fundraising

Kendra's students have taken numerous trips: to the Environmental Protection Agency in Pensacola; to the Florida Keys to study mangroves, seagrass beds and coral reefs; and to the Crystal River to study manatees.

Kendra teaches marine biology at Escambia High School, a curriculum that includes aspects of aquatic ecology, such as material on water quality, legal issues of water, and water use in the home. About once a month, Kendra offers a trip away from school. She believes it's important to get kids out in the field to get hands-on experience with what they're studying.

"The trips add a lot to the curriculum," Kendra says. "Connections are made when we talk about water used in the home and then go to the sewage treatment plant. It's often the first time students fully realize where their water goes. Following this unit is a unit on estuaries. Students first study estuaries in the classroom and then take a trip to see them. Again, students learn that it's all one big system." Kendra also organizes several cleanups each year, one along the river and the other to clean up one of the Barrier Islands' beaches.

Although the trips expand and reinforce concepts learned in class, it takes perseverance to get them organized. "At first it was discouraging to get these trips going," Kendra remarks. "The administration was hesitant. They were concerned that a trip to the beach would simply be a day of sunbathing. I had to convince them that we were, in fact, going to be wading and digging in black, stinky muck, looking for worms and other aquatic organisms."

Kendra Grove
Escambia High School
Pensacola, Florida 32504

There were also other hurdles, such as arranging transportation and the lack of adequate insurance. "I found you have to be creative on how to take these trips," says Kendra. "When I first started, I went as far as to get my county bus driver's license, so that I could be the one to drive the bus and not run up extra costs for the school. You really have to make it happen, and gradually, after a trip here and there, the administration no longer questions you."

On the more extensive trips, Kendra discovered they needed to have better insurance coverage. Consequently, she started a 4-H club, which offers better coverage. Now, any student who comes along on these bigger trips also becomes a 4-H member.

Despite all this preparation, Kendra emphasizes that the trips are worth the trouble. "The students get so much out of them, and it gives them something to do and look forward to instead of hanging out at the local convenience store after school.

"Rachel was one of the typical convenience store groupies, but when she heard about my Florida Keys trip last year, she started working odd jobs after school and saving her money," says Kendra. "The trip costs $400 and her parents cannot afford that much money. They are, however, supportive of her endeavors and happy that her after-school activities have become more productive."

"**The administration was hesitant.** They were concerned that a trip to the beach would simply be a day of sunbathing. I had to convince them that we were, in fact, going to be wading and digging in black, stinky muck, looking for worms and other aquatic organisms."

Kendra likes her students to turn a trip into something they can take back and share with the rest of the school. Recently, a number of students have been working on a play they will put on for an elementary school class. "It's amazing," exclaims Kendra, "they've been there everyday after school for two weeks, writing and working on this play. I don't have to do anything, but provide the space. They're doing it all on their own." ■

A Rainforest Takes Over School

Level
- Middle School

Story Focus
- Enlisting Administrative Support
- Enlisting Community Support
- Locating Instructional Resources
- Building Skills: Workshops, Courses, Inservice
- Networking With Other Educators

The rainforest Rosalie Cochran and her seventh-graders build in their classroom grows like long vines that travel down the hall each year and capture the entire school's imagination. It started when Rosalie; after 17 years of teaching, began creating her own environmental education curriculum.

Rosalie's curriculum covers climate change, ozone depletion, prairie restoration, groundwater, solid waste and world food supplies. But the first topic has a reputation among students as the highlight: six weeks spent studying tropical rainforests.

During that time, students turn the classroom into a rainforest. Humid and lush, it chimes with parrot and peccary calls. Vines, trees and epiphytes of the tropical jungle hang above humidifiers while tape recorders play rainforest sounds.

It doesn't stop there, though. In shop class, students build bases for trees. In English classes, students write, revise and send letters to figures such as the President of Brazil. In math labs, teachers help students compile data and statistics on rainforest depletion. Social studies students explore the culture and politics of tropical countries. To develop life skills, the students investigate a conservation organization that protects plots of rainforest. After determining it was a sound organization, the class earned enough money to buy twenty acres.

Rosalie Cochran / Diane Whitney
Fairfield Middle School
404 West Fillmore
Fairfield, Iowa 52556

Emphasis in Rosalie's classroom is placed on fairness and participation. Students express their thoughts freely, and learn that their opinion counts. The study methods she uses are based on recommendations from the University of Northern Iowa's Environmental Issues Instruction program. In the e.i.i., students work through a four-step process. The first two involve identifying the players involved, their positions and values, and the ecological foundations surrounding the problem. Then students do an in-depth investigation that includes library research and soliciting opinions of local citizens. Finally, after looking at many sides of the issue, they determine what should be done to help solve the problem.

The rainforest project now involves almost every teacher in the building. It has sparked great creativity, inspiring many teachers to incorporate more environmental themes into their classes. Diane Whitney, who teaches home economics lab, has since attended e.i.i. workshops

and devised weeklong sections on tropical rainforests and global climate change. Her students perform energy audits on appliances in their homes and inventory food and furniture with origins in the tropics. Diane's curriculum requirements include units on housing, money management and food and nutrition. At first she thought environmental topics would be difficult to adapt to her curriculum. Yet, Diane says, the new additions fit right in and greatly benefited her course. "It's great to be able to share information with other teachers in the school," Diane adds.

> "The rainforest project now **involves** almost **every teacher** in the building. It has **sparked great creativity, inspiring** many teachers to incorporate more environmental themes into their classes."

The first time Rosalie tried her curriculum, she invited the principal to sit and watch an e.i.i. workshop. He gave her the go ahead to develop a year-long trial program. The trial surpassed everyone's expectations. With administrative support, the new course work earned parent and community praise, newspaper attention, and school board support.

Positive responses continue to come in. Former students return, telling of continued involvement in the same issues she raised with them. The Brazilian president has responded to student letters. And, in perhaps the most stirring recommendation of all, Rosalie Cochran says that she's had more fun in the five years she's done environmental education than during the rest of her long teaching career! ■

One Fish, Two Fish, Red Fish, School Fish

There's something fishy about Aline Novak's teaching approach.

Three years ago, she hauled 55-gallon drums for goldfish into her classroom at Clear Spring High School in western Maryland. Now, she has added a several hundred gallon milk tank full of trout. Her biology classroom is buzzing with research projects as students study local agricultural practices and their impact on the aquatic environment.

Level
- High School

Story Focus
- Enlisting Administrative Support
- Enlisting Community Support
- Locating Funding: Grantwriting

The 440-student school is nestled in quiet countryside. The local economy is so rooted in agriculture the school has a department for agriculture, just as it does for English and science. In 1990, Aline wanted to combine science and agriculture in a hands-on project.

"I've always been excited by water issues," she says. "It seemed logical to combine my knowledge with the most important community issue."

What developed was a soil-less system of producing vegetables using water from 55-gallon drums filled with goldfish. The nutrient-enriched water was pumped to the plants. And students could watch plant growth happen right under their noses.

The following year, students designed a more complicated experiment. Using the same 55-gallon drums, they stocked the tanks with trout and added small amounts of Atrazine, a herbicide popular in their area. This time, they were looking for a correlation between use of Atrazine and its presence in the fatty tissue of the fish. The results supported research done at the Maryland Department of Natural Resources' Tidewater Administration. Atrazine showed up in the fish.

Aline Novak
Clear Spring High School
12630 Broadford
Clear Spring, Maryland 21711

The program has continued to grow. This year, grants from the Chesapeake Bay and the Tidewater Administration allowed Aline to purchase an old bulk milk tank, new water pumps and a water-quality testing kit. The several-hundred-gallon tank will provide a more natural habitat for the trout. Aline's goal is to sustain the fish for a longer period, so that the students can compare the quality of local lake water with the quality of water in the trout tank. "It will be interesting to see if our lake water quality is good enough to support trout, which are very dependent on good water," she says.

Aline Novak's passion for biology and environmental science came from her own experience in high school biology. For 17 years, she's been passing that same passion on to her students. But the effort hasn't been easy, Aline concedes: "You have a great idea, but the money is always hard to find." While her school administration has been supportive, it has been up to her to secure funding. It has taken ingenuity, determination and persistence to make her dream of providing fun, exciting and memorable environmental education a reality. ■

The Sky's the Limit

Level

- Middle School

Story Focus

- Enlisting Community Support
- Networking With
- Other Educators
- Locating Funding: Grantwriting

As Debra Mullinnix moves through the rows of emerging potato plants, she pulls out a weed here and there. "Although these roots give support to the soil, they steal valuable nutrients away from the potatoes. Since we're not talking of a soil that is particularly vulnerable to water and wind erosion, clean weeding is ecologically safe, and the stems of these weeds can be composted and used later to replenish the soil. This is the kind of agricultural and ecological complexity which is very valuable for children to see and feel firsthand. They don't understand it when they read it in textbooks, but when they are out here digging with their hands, it instills some degree of responsibility into their heads."

Mullinnix, a seventh-grade honors life science teacher at Wunderlich Intermediate School in the Klein Intermediate School District in Houston, Texas, developed the idea for a working, student-run garden. She is currently writing a proposal for a thousand-dollar grant, which would allow her to increase the area under cultivation. "The thousand dollars would let us plant a garden 70 feet by 25 feet, and buy seeds, garden tools, and a strong fence to keep out small animals."

Debra Mullinnix
Wunderlich Intermediate School
9406 Dornoch
Spring, Texas 77379

Mullinnix stops and sits in the dirt between rows, fingering one of the small shoots uncurling from the soil. "Young kids look at these and see some magical element of growth showing itself. By giving them hands-on knowledge about how seeds germinate, stages of growth, soil nutrition, decomposition, and so on, you might take away a bit of the mystery, but you give them an everlasting appreciation of the complexity and the interdependence of the Earth's ecosystems. They might not retain any of the detailed information later in life, but they will retain a perception that they are personally affected by the natural world, and will therefore take action where it is needed. Besides, many people's career interests begin in middle school. If I can possibly spark a life-long interest for even one seventh-grader, this is an important feat."

The gardening project is maintained solely through the efforts of students, and most of these efforts are self-initiated and then carried out with guidance from Mullinnix. "All of the work is done in small groups," she says. "They decide upon an aspect of the garden to investigate and research their subject through various means, including community surveys, library research and the questioning of specialists. From this research, students decide which type of seeds to grow, which type of fertilizer to use and other important choices. They come up with a hypothesis (for example, that chemical fertilizer and composted fertilizer will affect plants differently), and test this hypothesis out in the garden, analyzing the data and presenting their findings to the class as a whole."

This project allows the opportunity for community interaction, bringing in local experts from nurseries or pesticide companies to speak with the students. "It's really a great way to bring some of the different schools of thought together. And it doesn't take a major time commitment. The garden takes about three days to set up. All the work is done during my class time." Once the garden is set up, there is a need only for periodic time allotments to make observations or do the necessary weeding. Mullinnix also hopes to begin a joint garden project, with each of her students working with a student from the special education class.

"The possibilities are endless. It is a fairly easily managed project with enormous benefits. The students were a little hesitant at first being torn away from textbook education, but now many of them go home excited and talking about the garden. And it's the kind of thing which is passed along from teacher to teacher. Already, I have heard interest from the special education teacher and the sixth-grade teacher about starting similar projects. The main effort is in setting up. After that, the sky's the limit."■

"Young kids look at these and see some magical element of growth showing itself. By giving them **hands-on knowledge** about how seeds germinate, stages of growth, soil nutrition, decomposition, and so on, you might **take away a bit of the mystery,** but you give them an **everlasting appreciation** of the complexity and the interdependence of the Earth's ecosystems."

"Have You Seen My Slender Salamander?"

Level
- High School

Story Focus
- Enlisting Community Support
- Locating Funding: Fundraising
- Locating Funding: Grantwriting

A trail of giggles followed the student as he left the crowded school library and strode down the hall. As he approached, the cause of amusement became clear: The button pinned to his T-shirt asked, "Have you seen my slender salamander?"

Gary Smith, a biology teacher at Katella High School in Anaheim, California, explains: "California has over 200 endangered species, and we wrote the name of every species on butcher paper. The roll ended up being 20 feet long, and we had to drape it over the second story balcony of the school. As if that wasn't noticeable enough, my students wanted to raise awareness even further about endangered species—and make a little money for our projects—by selling buttons. We came up with a couple different slogans for the buttons, like "Have you seen my . . ." or "Would you like to hold my . . ." with the names of the species inserted. All the buttons were gone in ten minutes. The salamander buttons were the first to sell out."

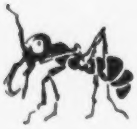
Students of color make up a majority of the population of Katella High School. In order to get his students to "buy into" the environment, Gary believes it is important to show respect for their particular cultures and environment. Teachers have to "tie the human environment to the natural environment through environmental education activities that involve collaboration, negotiation, agreement, and problem-solving," he says. Gary's students learn that homelessness and poverty are as much environmental issues as the endangered species they wrote on the butcher paper.

"Every year, each of my classes sponsors one or two children overseas, usually through an organization called World Vision," Gary says. "That's just one of the environmental projects for which my students need to raise money. In addition to the endangered species buttons, one year we sold some very popular T-shirts to raise money for the Anaheim Relief project. Another year, we sold baked goods each Friday. We made about $80 per week selling the goodies to the other students."

Gary Smith
Katella High School
2204 Lisbeth Ave
Anaheim, California 92806

Not only do students work to raise money, but they also decide what to do with it. The school regularly donates to a homeless shelter, and sponsored "Trick or Can" on Halloween to collect canned goods. Over the years, students have purchased rainforest property, planted ecologically adapted, native plants on the school's open campus, and bought books on environmental topics for the school library.

"This year we bought a number of copies of the World Watch Institute's *State of the World* publication," Gary says. "We sent copies to the principal, the mayor, the city council and the superintendent of schools. The governor also got a copy. Even our U.S. senators and representatives got copies of *State of the World*, all inscribed with the words, 'From the students of Katella High School, Anaheim, California.'" ■



Big Brothers, Big Sisters

Level

- High School

Story Focus

- Enlisting Administrative Support
- Enlisting Community Support
- Locating Instructional Resources
- Building Skills: Workshops, Courses, Inservice
- Networking With Other Educators
- Locating Funding: Grantwriting

"That's a dragonfly nymph, and that's a mayfly nymph. And, oh look, there's a dobson fly larva," the eager student explains to his 'little brother.' The students are a part of Miriam Turner's 'big brothers and big sisters' program which pairs Detroit Renaissance High School students with special needs students from nearby King Elementary School.

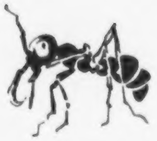
Miriam's students work in teams and are responsible for helping one or two of the King elementary school students learn the water quality tests. "Not only does this help my students to understand the material better, but it has helped them see the special needs students in a different light. Many of my students have remarked how good it feels to motivate and give a sense of self-esteem to their 'little brother or sister.'"

The partnership between Miriam's class and the King students extends beyond the water quality monitoring component. They communicate with one another over the EcoNet computer network. "Mainly they just ask each other how they are doing and what they are doing in school. But it's been a great way to teach both groups about using the computer as a communications tool."

Miriam Turner
Renaissance High School
6565 West Outer Drive
Detroit, Michigan 48235

Miriam has participated in the water quality program since it started five years ago. In addition to adding a 'big brothers and big sisters' component to the program, she has 'personalized' it with a variety of other twists. One year, her students acted as assistants for younger students at Taft Middle School. Three years ago, Miriam volunteered her class to participate in the pilot of a cross cultural partnership program, facilitated by the Global Rivers Environmental Education Network.

The cross cultural partnership program has brought a global perspective to Miriam's water quality monitoring unit. Her students trade letters and videos about their class, their school and the environment with their partner school, located in Sydney, Australia. They also share data about water quality and communicate about water quality problems and potential solutions. "We have all learned how, despite our differences in culture and geographical location, we have many of the same concerns and face many of the same challenges with regard to environmental issues," Miriam says.



As is evident from the water quality testing unit, Miriam employs a very hands-on approach to learning about Earth Sciences. She tries to take her classes on two or three field trips a month. Aside from the trip to perform water quality tests, they have visited the flood plains of the Rouge River, Detroit's waste water and drinking water treatment plants, and a local landfill. "It's important to take students on field trips to teach them about the environment and community they live in," Miriam explains.

Although the administration pays for her substitute teachers, Miriam must find the funds to cover the transportation costs. Given her school's tight budget situation, Miriam looks to outside funding sources. "I write a lot of grant proposals, lots and lots."

"It's important to take students on field trips to **teach** them **about the environment and community** they live in."

"When a professor at the University of Michigan first approached me about participating in the water quality monitoring project, I never would have guessed in my wildest dreams that my students would be so excited about a trip to the Rouge River, or that we'd be communicating with teachers and students in Australia," Miriam says. "And the parents are excited too. They say they really enjoy it when their children come home excited about school." ■

Recycling Snowballs

Level
- Lower Elementary

Story Focus
- Enlisting Community Support
- Locating Instructional Resources

Each week, the parents of Jackie Hines' third-graders get a weekly update on their children's recycling project.

"I usually include a piece in it, thanking the parents for supporting their child's new interest," Jackie says. "It's hard for children to get adequate hands-on experience with environmental issues at school. That's why I think parental modeling is so important."

It's not like Jackie's students aren't already letting their parents know about recycling. In class, students talk about their frustration after family trips to the town's lackluster recycling center.

"Kids say things like, 'My mom and I went to recycle, but the bins were full and spilling over!'" Jackie says. "Other children are honest about the fact that even if they save paper, their parents won't take them to the recycling center. Seven- and eight-year-olds are so trusting, honest and eager to please. They see that recycling is important, and want to get involved."

The children's enthusiasm for recycling has snowballed from the beginning. The children set up their own recycling system in the classroom. It made them appreciate that, even on a small scale, recycling requires effort and organization. At the same time, they were learning about local government. The children asked Jackie to write to city council about the municipal recycling system, and invite the mayor to come speak to their class. "We try to get the students involved in problem-solving with real-life issues, and the recycling issue really worked well," Jackie says.

Jackie Hines
Greenwood Elementary School
2300 Spruce St.
LaGrande, Oregon 97850

To prepare for the mayor's visit, the students listed questions about problems their families had with recycling. The mayor listened carefully to the children's concerns and explained budget issues at the heart of the drop-off center's problems. Yet another layer in the recycling problem-solving experience had been revealed.

Whenever possible, Jackie provides hands-on experience at school. In addition to recycling, she and her students look at ways to reduce and reuse classroom materials. "Instead of issuing the standard school supplies to every student each year, pencils, folders, etcetera, we try to get past that waste. We take a hard look at what supplies kids do and don't need, and we're really able to cut back. This of course led Jackie and her students into a discussion about supply and demand. . . and, so, the snowball keeps rolling! ■

Where Do Carrots Come From?

Rosa turns the corner onto 117th Street in Harlem, skipping 10 paces ahead of her mother. "C'mon Mom," she yells back, doing a little loop in her direction.

Level

- Lower Elementary

Story Focus:

- Enlisting Community Support
- Locating Instructional Resources
- Locating Funding: Fundraising
- Locating Funding: Grantwriting

It's Saturday, but they're headed back to school, specifically the school garden. It's been a couple weeks since they planted corn, and Rosa can't wait to see if it sprouted. When they arrive, Rosa's teacher at Public School 155, Sandra Jenore, is preparing for next week's classes.

The project started five years ago, when Sandra and a friend who has a grandchild attending the same school worked to convert a vacant city-owned lot next to P.S. 155 into a garden. The community planning board wanted to turn it into a parking lot. Sandra petitioned the city for the property and after a year of negotiation, the city cleaned out the lot and gave it to the school.

Each year, several classes plant vegetables and flowers. Each class gets an area, but there is also space for family plots. "It gives students a chance to do hands-on work, be outside and apply many concepts they learn in their classes," Sandra says, nodding toward the area where Rosa and her mother are gloating over their newly sprouted corn. "It's great to involve the parents in a school project."

The kids, of course, learn a great deal, from simple to complex ideas. "It's amazing because I've had instances where a student doesn't know what to do with the vegetables we grow," Sandra says. "One little girl, who participated in the whole process of planting and harvesting carrots, did not want to eat them. She thought they were too dirty, because they had been in the ground. She had no idea where carrots came from."

Sandra Jenore
Public School 155
319 E. 117th
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The garden has certainly been a highlight for the school, but it takes on-going financial support. Sandra began the garden with material from Cornell Extension Services and the city Parks Department. They sent seeds, tools, bulbs and flowers. Since then, she has written several grant proposals, including a recent one for a birdbath. "We're hoping to entice cardinals or blue jays, over from Central Park to our garden," Sandra says. "Anything other than pigeons."

Along with their curricular activities, Sandra's students raise money for garden supplies by collecting and recycling cans and aluminum foil. They also hope to buy magnifying glasses and butterflies.

"It's nice to add new elements to our garden," Sandra says. "And the kids are really excited. It's terrific when someone runs in on a Monday morning and announces that the tulips have bloomed or the beets have sprouted. I guess you know you're on the right track when the kids get interested in plants and figure out just where their food comes from." ■

An Interested and Energetic Force

From the right side of the Fort Benning School Auditorium, a tall, middle-aged woman dressed in a penguin costume begins to waddle across the stage. "You may think I slide through Antarctic ice, far from industrial-waste. But just a taste of poisoned fish swimming in haste through an oil slick can end my faith in nature's harmony. Everything on this planet is interdependent. . . " As the crowd applauds, another person, Jerry Christy, steps up to the microphone and delivers a short description of the ecological roles penguins play, complete with statistics and anecdotes from scientists, politicians, explorers and fellow educators.

Level
- Elementary

Story Focus
- Enlisting Administrative Support
- Enlisting Community Support
- Locating Instructional Resources
- Networking With Other Educators

Twelve years ago, Jerry was a member of the Science Education Curriculum Committee that recommended, developed, and implemented environmental education in the K-8 science curriculum. Presently he is the math, science and technology curriculum coordinator for the Fort Benning schools. "Of course, we can't do a presentation like the one we did on Antarctica for every subject, but occasionally it serves to bring together the community, students and teachers," he says.

The event was a smashing success. The idea came from a weeklong institute on Antarctica he attended in St. Paul, Minnesota with a social studies teacher. They returned wanting to combine lessons on Antarctica with presentations by school volunteers, from teacher aides to assistant superintendents.

Jerry Christy
Fort Benning Schools
P.O. Box 1967
Fort Benning, Georgia 31905

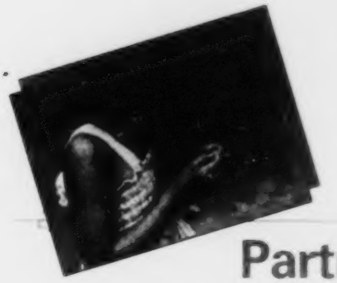
When Jerry was given the task of making environmental education part of the school curriculum, he was teaching fifth-and sixth-grade science. Then he could test environmental topics daily to find out what interested students and what topics were manageable in classroom settings. "Once the curriculum was developed and I began working with kids, their obvious enthusiasm for environmental topics was energizing. Never before had I seen students get so involved and committed in their efforts."

Although Jerry's present position is administrative, he spends a good portion of his time working with teachers and students on a consulting basis, helping to design and implement environmental education projects. "Many of these feature telecommunications," he says. "There is the International Arctic Project, for which we are one of the development-team schools and have come up with a study project related to land use and habitat displacement. We're also involved in two of the National Geographic Kids' Network projects (on weather and acid rain), and are building a 20-foot by 35-foot fully functional greenhouse for Project Green Thumb. Ideas and recommendations for projects often come from faculty members. Three teachers proposed the idea of the greenhouse.

Jerry likes matching Fort Benning's environmental education program with wider objectives. "The most interesting aspect of the process has been the realization that our original focus on teaching teachers a new way of doing things was not enough. We also have to teach students a new way," he says. "From about third grade on, they have a sense of what school is 'supposed' to be and how it is to be 'played'. What we are providing them violates the rules, and students can sometime feel uneasy with it."

Jerry sees a bright future for environmental education at Fort Benning. "Luckily, we have a very supportive school board and professional development program for faculty and staff. That's one of the things that's so invigorating about environmental education — it pulls together the various sections of the community into one interested and energetic force," he says. ■

"From about third grade on, they have a sense of **what school is 'supposed' to be** and how it is to be 'played'. What we are providing them violates the rules, and students can sometime feel uneasy with it."



Partners in Philanthropy

"It's not so unusual to hear the cry 'dead ants, dead ants' coming from some of the classrooms of the Mast Landing School," Margaret Pennock explains as we walk down a hallway filled with elementary school students. "And if it's not 'dead ants, dead ants,' it's 'boogie woogie, boogie woogie'!" Margaret shakes her head and laughs as she recalls the semester two years ago when she developed Partners in Philanthropy.

Level
– Upper Elementary

Story Focus
– Enlisting Administrative Support
– Locating Funding Grantwriting

"The students struggled through the process of deciding what non-profit group in their state should receive a $10,000 grant," she says. "'Dead ants' and 'boogie woogie' were only a small part of this amazing process."

The one-time project began when the principal circulated a letter from the Maine Community Foundation, expressing the foundation's interest in giving youth groups an opportunity to improve the quality of life in Maine. The foundation wanted to give students the responsibility of deciding where to donate a $10,000 foundation grant. The only restrictions were that this group of young students receiving the grant had to be non-profit, located in the state of Maine, and the money had to be given to one group ($10,000), or to two groups ($5,000 each).

Margaret Pennock
Mast Landing School
Soule Program
Bow Street
Freeport, Maine 04032

"I really felt such an opportunity fit nicely with the school's philosophy of giving kids real responsibility and providing them with real decision-making situations," Margaret explains. "When I received the grant of $10,000, to give away, I decided to make the decision of where to give the money the focus of my interdisciplinary unit for that semester. I called the unit Partners in Philanthropy."

"One of the most amazing aspects of it was that my role was solely that of facilitator," she says. "I presented the group with options when asked, but never gave my opinions. More than anything else, Partners in Philanthropy was about developing group process skills."

First, the group established their possible areas of concern, which they narrowed to two issues: the environment and animal rights. They used the "Alternative Yellow Pages" of Maine to find and research groups in Maine working on these issues. As they got down to specifics, discussions grew tense as students were forced to really listen to what others had to say.

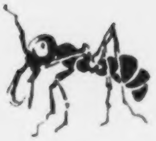
"That's where 'dead ants' and 'boogie, woogie' came from," Margaret explains. "We made it our policy that whenever the group confronted what seemed like an insurmountable mental block, someone could shout 'dead ants, dead ants' or 'boogie woogie' and everyone would scatter to the floor and lie on their backs, jiggling their hands and feet into the air. The comic relief worked wonders," Margaret recalls with a chuckle bordering on disbelief. "It really, really, worked. And the students were very responsible about using it. They used it only when they really were confronting a block and not as a way to have fun for the sake of having fun."

The students devised their own criteria for selecting the group. "They knew that the group needed to fulfill the stipulations of the Maine Community Foundation," Margaret says, "but they also felt very strongly that the group was not to use the money primarily for administrative purposes, and the group had to have direct impact on the problems that they worked on." The students then debated whether their decision was going to be by consensus, majority vote or even picking a name out of a hat. They decided it would be by consensus.

"A great **whoop of delight** filled the air and **the class erupted** in a spontaneous chorus of **'boogie woogie'**!"

After days of tough discussions, they came up with two potential groups: The Animal Rights Protection Group of Maine and the Children's Rainforest. They arranged for interviews of representatives of each group. "Although they were a bit shaky at first, they quickly centered in on those things that were most important to their decision. They asked some hard questions like 'What would happen to the money if that group got it?' and 'How much would be spent on office overhead?' They really grilled those reps!," Margaret says.

Deliberations about the final choice continued into the last day of the class. "The group had long before agreed that the final decision should be by consensus, and two of the students weren't fully comfortable with the majority view. I sensed that the group was growing tense, and that the pressure was beginning to mount on two students to change their opinions. It was amazing just how quiet that room got. I was beginning to fear for the worse; that no decision was going to be made. Or worse yet, I was afraid that the two dissenters would be pressured into changing their minds and forever be dissatisfied with the group outcome.



The group was definitely confronting its most serious challenge of the program. But just when things seemed hopeless, one of the students spoke up in defense of the two dissenters' right to not agree with the majority and asked everyone to re-think their decision. That really was a turning point. Until that point, the group hadn't really recognized the validity of other opinions as they struggled toward getting everyone to agree with the majority.

"I had struggled with whether to step in and encourage the group along in this direction. But I had long before stepped aside as facilitator and I felt strongly that it was more important that they struggle with the process themselves than to force a decision. As it turned out, once the two dissenters felt that the other members of the group were respecting their opinions, things began to move. I was very impressed with the way those kids worked this issue out amongst themselves. I mean, that's a very difficult thing even for adults working in groups to do!"

With ten minutes left in the last class, the two dissenters said that although they still disagreed with the group's decision they felt it was more important that the group be able to give the money to someone and they voted in favor of the group's decision. The group had reached consensus. They would donate the money to the Children's Rainforest. "A great whoop of delight filled the air" says Margaret, "and the class erupted in a spontaneous chorus of 'boogie woogie'!" ■

Resource Indices

National Non-Profit Environmental Organizations

American Oceans Campaign
725 Arizona Avenue, Suite 102
Santa Monica, CA 90401
(310) 576-6162

Adopt A Stream Foundation
P.O. Box 5558
Everett, WA 98201
(206) 388-3313

Carrying Capacity Network
1325 G Street NW, Suite 1003
Washington, DC 20005
(202) 879-3045

The Center for Economic Conversion
222 View Street
Mountain View, CA 94041-1344
(415) 968-8798
Fax (415) 968-1126

The Center for Marine Conservation
1725 DeSales Street, NW, Suite 500
Washington, DC 20036
(202) 429-5609

The Conservation Fund
1800 North Kent Street
Suite 1120
Arlington, VA 22209
(703) 525-6300

The Cousteau Society
870 Greenbrier Circle
Suite 402
Chesapeake, VA 23320
(804) 523-9335

Environmental Defense Fund
257 Park Avenue South
New York, NY 10010
(212) 505-2100

The Environmental Exchange
1718 Connecticut Ave. NW
Suite 600
Washington, DC 20009
(202) 387-2182

Global Tomorrow Coalition
1325 G Street, NW
Suite 915
Washington, DC 20005-3104
(202) 628-4016

Global Releaf
Director of Education
P.O. Box 2000
Washington, DC 20013
(202) 667-3300

Izaak Walton League of America
1401 Wilson Boulevard
Level B
Arlington, VA 22209-2318
(703) 528-1818

Keep America Beautiful Inc.
Mill River Plaza
9 West Broad Street
Stamford, CT 06902
(203) 323-8987

League of Conservation Voters
1707 L Street, NW
Suite 550
Washington, DC 20036
(202) 785-8683

National Audubon Society
700 Broadway
New York, NY 10003
(212) 979-3000

The National Geographic Society
1145 17th Street, NW
Washington, DC 20036
(202) 857-7000

The National Institute for Urban Wildlife
10921 Trotting Ridge Way
Columbia, MD 21044
(410) 995-1119

National Parks and Conservation Association
1776 Massachusetts Avenue
Washington, DC 20036
(202) 223-6722

National Toxics Campaign
29 Temple Place
5th Floor
Boston, MA 02111
(617) 482-1477

National Wildlife Federation
1400 Sixteenth Street, NW
Washington, DC 20036-2266
(703) 797-6800

The Nature Conservancy
1815 North Lynn Street
Arlington, VA 22209
(703) 841- 5300

North American Association for Environmental Education
1255 23rd Street NW
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(202) 467-8753
Membership and Publications:
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Troy, OH 45373
(513) 676-2514

Population-Environment Balance
1325 G Street, NW
Suite 1003
Washington, DC 20005-3104
(202) 879-3000

Project Eco-School
881 Alma Real Drive
Suite 300
Pacific Palisades, CA 90272
(310) 454-4585

Renew America
1400 Sixteenth Street, NW
Suite 710
Washington, DC 20036
(202) 232-2252

The Sierra Club
730 Polk Street
San Francisco, CA 94109
(415) 923-5660

Soil Conservation Society of America
7515 NE Ankeny Road
Ankeny, IA 50021
(515) 289-2331

World Resources Institute
1709 New York Avenue, NW
Washington, DC 20006
(202) 662-3085

Worldwatch Institute
1776 Massachusettes Avenue, NW
Washington, DC 20036
(202) 452-1999

The World Wildlife Fund
1250 Twenty-Fourth Street, NW
Washington, DC 20037
(202) 293-4800

Zero Population Growth
1400 16th Street, NW
Suite 320
Washington, DC 20036
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State, Regional and Territorial Environmental Education Associations and Organizations

This list includes information compiled by the North American Association for Environmental Education and U.S. Environmental Protection Agency Regional Environmental Education Coordinators.

* As of 1993, these states do not have an EE organization or association. The individuals listed serve as EE contacts for their area.

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Conservation Education Center
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6431 University Avenue
Fridley, Minnesota 55432

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111 Jefferson Street
Jackson, Mississippi 39202

State, Regional and Territorial Environmental Education Organizations, (continued)

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600 Kiwanis Drive
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P.O. Box 928
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Chairman
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Incline Village, Nevada 89450-8867

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P.O. Box 105
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New Jersey Audubon Society
P.O. Box 693
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Phillip Costello
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P.O. Box 3315
Long Beach, New Jersey 07740

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New Mexico Environmental
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P.O. Box 474
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New York State Outdoor
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P.O. Box 148
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315 Pittsboro Street, CB #7410
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West Virginia Conservation
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Amherst Junction, Wisconsin 54407

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Wyoming Association
for Environmental and Conservation
Education
c/o Wyoming Conservation Connection
P.O. Box 3992, WYO Hall
University of Wyoming
Laramie, Wyoming 82071-3992

Director
Wyoming Outdoor Council
210 West Main Street
Lander, Wyoming 82520

Wyoming Conservation Association
Math Science Teacher Resources
University of Wyoming
Laramie, Wyoming 82070

TVA-Sponsored Environmental Education Centers

Bear Creek Watershed Environmental Education Project
Mr. Allan M. O'Neal, Jr., Director
Russellville, AR 35653

Cedar Creek Learning Center
Mr. Doug Ratledge, Director
Greene County Schools
910 W. Summer Street
Greeneville, TN 37743

Center for Environmental/Energy and Science Education
Dr. Charles R. Rhyne, Director
Plant Science Building
Jackson State University
Jackson, MS 39217

Center for Environmental/Energy Education
Ms. Jill Norvell, Director
College of Education, Room 415B
Memphis State University
Memphis, TN 38152

Center for Environmental/Energy Education
Dr. Patrick Doyle, Director
Dr. John Duboise, Co-Director
Middle Tennessee State University
Murfreesboro, TN 37132

Mississippi Cooperative Extension Service
Mr. Jim Yonge
Mississippi State University
Mississippi State, MS 37926

Center for Environmental Education
Dr. Ruth Jacquot, Director
Murray State University
Murray, KS 42701

Center for Science, Mathematics, and Environmental Education
Dr. Susan P. Gannaway, Director
Education Building, Room 306
North Georgia College
Dahlonega, GA 30597-9990

Center for Environmental/Energy Education
Dr. Joe Sharp, Director
301 Bartoo Hall
Tennessee Technological University
Cookeville, TN 38505

Center for Environmental Education
Dr. Ed Cox, Director
Dr. Jackie Batson, Co-director
Tennessee Wesleyan College
Athens, TN 37303

Center for Environmental/Energy Education
Mr. Bernard Levine, Director
Wilson Hall, Room 201
University of Alabama in Huntsville
Huntsville, AL 35899
(205) 895-6272

Center for Environmental, Energy, and Science Education
Dr. Earl Gardner, Director
Dr. Mary Lou Meadows, Co-Director
Math Building
The University of North Alabama
Florence, AL 35632-0001

Center for Environmental, Energy, and Science Education
Dr. Bernard Benson, Director
Room 204, Hunter Hall
The University of Tennessee-Chatanooga
Chatanooga, TN 37403

Center for Environmental/Energy/Science Education
Dr. Webb Slawson, Director
Dr. Rosalyn McKeown-Ice, Co-Director
Claxton Addition 319
The University of Tennessee-Knoxville
Knoxville, TN 37996-3400

Center for Environmental and Conservation Education
Dr. Maurice Field, Director
The University of Tennessee at Martin
210 Frank Clement Hall
Martin, TN 38238

Center for Environmental/Energy/Education
Dr. Richard C. Berne, Director
Natural Sciences Building, Room 333-A
Western Carolina University
Cullowhee, NC 28723

Center for Math, Science, and Environmental Education
Dr. Terry Wilson, Director
Mrs. Joan Martin, Program Coordinator
403 Tate C. Page Hall
Western Kentucky University
Bowling Green, KY 42101

US EPA

U.S. Environmental Protection Agency
Environmental Education Division
(1707)
401 M Street, SW
Washington, DC 20460
(202) 260-4962 or (202) 260-4965

U.S. Environmental Protection Agency
Public Information Center
401 M Street, SW
PM-211B
Washington, DC 20460
(202) 260-7751

US EPA Regional Environmental Education Coordinators

Region 1–CT, ME, MA, NH, RI,VT
Maria V. Pirie
U.S. EPA, Region 1
JFK Federal Building (RPM)
Boston, MA 02203
(617) 565-9447

Region 2–NJ, NY, Puerto Rico, Virgin Islands
Teresa Ippolito
U.S. EPA, Region 2
26 Federal Plaza (Room 905)
New York, NY 10278
(212) 264-2980

Region 3–DE, DC, MD, PA, VA, WV
Bonnie Smith
U.S. EPA, Region 3
841 Chestnut Street (3EA 20)
Philidelphia, PA 19107
(215) 597-9825
For publications call:
(215) 597-2176

Region 4–AL, FL, GA, KY, MS, NC, SC, TN
Rich Nawyn
U.S. EPA, Region 4
345 Courtland Street, NE
Atlanta, GA 30365
(404) 347-3004

Region 5-IL, IN, MI, MN, OH, WI
Suzanne Saric
U.S. EPA, Region 5
77 West Jackson Boulevard (PI-19J)
Chicago, IL 60604
(312) 353-3209

Region 6–AR, LA, NM, OK, TX
Sandy Sevier
U.S. EPA, Region 6
1445 Ross Avenue (6X)
Dallas, TX 75202
(214) 655-2204

Region 7–IA, KS, MO, NE
Rowena Michaels
U.S. EPA, Region 7
726 Minnesota Avenue
Kansas City, KS 66101
(913) 551-7003

Region 8–CO, MT, ND, SD, UT, WY
Cece Forgét
U.S. EPA, Region 8
Denver Place
999 18th Street
Suite 500 (80 EA)
Denver, CO 80202-2466
(303) 294-1113

Region 9–AZ, CA, HI, NV, American Samoa, Guam, Pacific Trust Territories
Ida Tolliver
U.S. EPA, Region 9
75 Hawthorne Street (E2)
San Francisco, CA 94105
(415) 744-1581

Region 10–AK, ID, OR, WA
Sally Hanft
U.S. EPA, Region 10
1200 Sixth Avenue (SO-141)
Seattle, WA 98101
(206) 553-1207

Appendices

Appendix A-1:

Select Instructional Material in Environmental Education

For All Grades

Conserving Soil.
USDA Soil Conservation Service. Available from the National Association of Conservation Districts Service Dept., P.O. Box 855, League City, Texas 77573-9989.

> Includes color transparencies, ditto masters, activities, and background information to help teachers convey information about soil and its wise use.

The Kid's Guide to Social Action.
Barbara A. Lewis, 1991. Free Spirit Press, Minneapolis, Minnesota.

> The *Kid's Guide* is an easy-to-use guide to social action. It includes stories about real kids that have made a difference, step-by-step guides to social action skills, ready-to-use tools, and an up-to-date resource guide.

Humanizing Environmental Education: A Guide for Leading Nature and Human Nature Activities.
Clifford Knapp and Joel Goodman, 1981. Published by and available from the American Camping Association, Martinsville, Indiana 46151.

> This is an excellent resource for building a sense of community among a group of people in an environmental setting (i.e., camp) or classroom. Hundreds of valuing and affirming activities accompany the text on humanistic education.

Our Great Lakes Connection: A Curriculum Guide for Grades Kindergarten Through Eight.
Lynn Entine, 1985. Wisconsin Sea Grant Program of the University of Wisconsin, Environmental Resources Center, 216 Agricultural Hall, 1450 Linden Dr., Madison, Wisconsin 53706.

> Twenty-four creative classroom activities take science, social studies, music, and language to the Great Lakes through investigations of sand, navigation, voyageurs, immigrants, mining, shipping, and toxic chemicals. Each activity includes some background, procedures, extensions, handouts, and a list of resources.

Project Learning Tree: Supplemental Activities for Grades pre-K through 8 and Educational Modules for Grades 7 through 12.
Western Regional Environmental Education Council and the American Forest Foundation. American Forest Foundation, Washington, DC. Available only through a six hour workshop. Contact PLT for the name

of the PLT coordinator in your state. Project Learning Tree, 1111 19th Street, NW, Suite 800, Washington, DC 20036. (202) 463-2462.

PLT uses trees as the vehicle for exploring our use of forest resources and interdependence in an easy-to-use interdisciplinary activity manual. Each activity includes learning objectives, background information, and a list of suggested extension activities. Included is an excellent bibliography and cross reference guide. New materials include thematic modules for older students.

Project WILD: Activity Guides for Grades K through 12

Western Regional Environmental Education Council, 1992. Available only through a six hour teacher workshop. Contact Project WILD, 5430 Grosvenor Lane, Bethesda, Maryland 20814, (301) 493-5447 for the name of the Project WILD Coordinator in your state.

The project WILD activity guide is a set of interdisciplinary activities based on wildlife, animal ecology, and the human connection to wild animals. A second guide, Aquatic WILD, focuses on water-related wildlife activities. Each activity includes learning objectives, background information, and a list of suggested extension activities.

Project WET

Available only through a six hour teacher workshop. Culbertson Hall, Montana State University, Bozeman, Montana 59717-0057. Call (406) 994-5392 for the name of the Project WET Coordinator in your state.

Project WET is a set of interdisciplinary activities based on water quality and water ecosystems. Each activity includes learning objectives, background information, and a list of suggested extension activities.

Standing Tall

The Giraffe Project. 1990. Langley, Washington. The Giraffe Project, Box 759, Langley, Washington 98260. (206) 221-7989.

The Giraffe Project is a national organization inspiring people to stick their necks out for the common good. *Standing Tall* is a service-learning program helping students in grades K-12 to build confidence in their abilities to take thoughtful action to better the world around them; to develop an enduring vision that service and good citizenship are essential parts of a meaningful life; and to acquire critical skills in thinking, decision-making, leadership and cooperation. Each teaching guide includes a complete set of lesson plans, student handouts and enrichment ideas.

Touch a Tree, Forest in My Classroom, and other publications.
Western Education Development Group, Faculty of Education,
University of British Columbia, Vancouver, BC V6T 1Z5.

A wonderful series of resource books was written by teachers, for teachers on a wide variety of topics: *Touch a Tree, Forest in my Classroom, Forest Appreciation, There's Dirt in the Forest, Stump Book, Seeing Through the Trees, Measuring the Forest, Rain Book, Snow Book, Pond Book, Lake Book, Herbal Happening, Art Starts Outdoors, etc.*

Instructional Materials in Environmental Education for Elementary Teachers

Acclimatization, 1974
Acclimatizing, 1972
Sunship Earth, 1979
Earth Education: A New Beginning, 1990
Steve Van Matre. American Camping Association, Martinsville, Indiana and the Institute for Earth Education, Box 288, Warrenville, Illinois 60555.

Van Matre first popularized the sensory approach to environmental study. *Acclimatizing* and *Acclimatization* describe short activities and adventures to discover the outdoors. *Sunship Earth* is a carefully structured five-day residential outdoor program. The magic and discovery are still there, but the emphasis is on the larger picture of ecology and human interactions.

Connections: A Curriculum in Appropriate Technology for the Fifth and Sixth Grades.
Written in 1980 by and available from the National Center for Appropriate Technology, P.O. Box 3838, Butte, Montana 59701.

This activity guide for elementary teachers provides exciting ideas and information in solar energy, water conservation, transportation, recycling, nutrition, and gardening–a good beginning for understanding many current issues.

Food First Curriculum.

Laurie Rubin, 1984. Published and available from the Institue for Food and Development Policy, 1885 Mission Street, San Francisco, California 94103.

> Population pressures, resource distribution, development, and lifestyle choices are integral to our global food and hunger dilemma. This curriculum, targeted to 6th grade but easily adapted, sensitively explores these issues. Differences in cultures, sources of food, the food distribution system, causes of hunger in the Third World and the U.S.A., and avenues for change are addressed in activities with teacher information, handouts, objectives, and evaluation.

Hug A Tree and Other Things to Do Outdoors with Young Children

Robert E. Rockwell, Elizabeth A. Sherwood, and Robert A. Williams, 1983. Gryphon House, Inc., Mt. Rainer, Maryland.

> One of the first EE manuals for very young children, this book guides teachers through a variety of outdoor and indoor activities that strengthen youngsters' skills in matching, comparing, observing, and exploring.

Keepers of the Animals, 1991.
Keepers of the Earth, 1989.

Michael J. Caduto and Joseph Bruchac. Fulcrum Publishing. Golden, Colorado 80401.

> Each book is a collection of Native American stories with related activities, promoting responsible stewardship toward all animals on earth.

Living Lightly in the City. Volume I for grades K-3, Volume II for grades 4-6.

Maura O'Connor and Kathy McGlauflin, 1990. Published by and available through Schultz Audubon Center, 1111 East Brown Deer Road, Milwaukee, Wisconsin 53217.

> *Living Lightly in the City* presents background information and teaching activities that help students understand the connections that maintain ecosystems.

NatureScope

National Wildlife Federation, 1412 Sixteenth Street, Washington, D.C. 20036. (800) 822-9919.

> *NatureScope* targets a different area of the environment in each issue: wetlands, mammals, pollution, birds, deserts, rainforests, weather, insects, etc. Each 64 page booklet is packed with teacher background, interdisciplinary activity ideas, resources, handout masters, and ideas to extend the theme.

Nature With Children of All Ages.
Edith Sisson, 1982. Englewood Cliffs, New Jersey.

Earthworm races, seed planting, aging a tree, winter temperature, migration reporting, and water testing, are some of the many activity ideas that fill this 200 page guide to nature study. It includes good ideas for elementary outdoor explorations.

Ocean: Consider the Connections.
Center for Environmental Education, 1985. Center for Environmental Education, 6624 9th Street, Washington, D.C. 20001.

Information and activites on our global waterways: waves, tides, animals, adaptations, ecosystems, and people are covered.

Outdoor Biological Instructional Strategies–OBIS.
Lawrence Hall of Science, University of California, Berkeley, CA. Available through Delta Education, Box M, Nashua, New Hampshire 03061.

This program promotes the understanding of biological and ecological relationships. Hands-on activities emphasize both the natural and built environments. Activities are packaged according to common themes: deserts, birds, school site, etc.

Sharing the Joy of Nature, 1989.
Listening to Nature, 1987.
Sharing Nature With Children, 1979.
Joseph Bharat Cornell. Ananda Publications, Nevada City, California.

The assortment of nature games and philosophy included in these books encourages youngsters and adults alike to increase their awareness of the world through direct experiences–like listening to tree heartbeats, following a soaring hawk, or stalking wild animals. The activities require no complicated equipment or expertise–just a sensitivity to people and nature.

Ten-Minute Field Trips: Using the School Grounds for Environmental Studies.
Helen Ross Russell, 1991. National Science Teachers Association, Arlington, Virginia.

Can't get a bus for a field trip? Your own school grounds are probably filled with days of environmental explorations. Trees, bugs, birds, worms, heat, and light are only some of the topics addressed in this information guidebook. Teacher preparation and field trip possibilities are listed.

Instructional Materials in Environmental Education for Middle and High School Teachers

Bags, Beakers, and Barrels: An Action Curriculum Toward Solving Hazardous Materials Issues for Middle and High School Students

Industrial States Policy Center, 1987. Industrial States Policy Center, 17 Brickel, Columbus, OH 43215.
(614) 224-4111.

> This guide enables teachers to help students understand hazardous materials, their usefulness, their danger, and their typical disposal pattern. The final chapter provides guidelines for developing an action project to help resolve local concerns about these materials.

Earth Matters: Studies for our Global Future, 1991.

USA by Numbers, 1984.

For Earth's Sake: Lessons in Population and the Environment, 1989.

Zero Population Growth, 1400 16th Street, NW, Suite 320, Washington DC 20036, (202) 332-2200.

> Zero Population Growth (ZPG) offers packets of activity ideas for approaching the sensitive issues of the environmental consequences of human population growth. Earth Matters, for example, provides background reading and activities on environmental issues at the secondary level. USA By Numbers uses census data to explain trends in environmental and social conditions.

The EarthTime Project.

Written in 1992 by and available from The EarthTime Project, P.O. Box 1111, Ketchum, ID 83340, (208) 726-4030.

> EarthTime is a program that stresses critical thinking skillls, personal responsibility, empowerment, and a hands-on approach to teaching environmental education. This program represents a blueprint for converting schools into models of environmental responsibility and affecting significant lifestyle changes among program participants. Based on issues that can be addressed at the school: energy conservation, water use, pesticides, etc.

Investigating and Evaluating Environmental Issues and Actions; Skill Development Modules and other publications.
Harold R. Hungerford, Ralph A. Litherland, R. Ben Peyton, John M. Ramsey, Audrey N. Tomera, and Trudi L. Volk, 1985. Stipes Publishing Company, 10-12 Chester Street, Champion, IL 61820.

> Written for middle school students, these skill development modules lead students through issue identification, values analysis, researching questions with serveys and questionnaires, and analyzing an issue for potential action.

Living Lightly on the Planet Volume I for grades 7-9, Volume II for grades10-12.
Maura O'Connor, 1991. Published by and available through Schultz Audubon Center, 1111 East Brown Deer Road, Milwaukee, WI 53217.

> *Living Lightly on the Planet* presents background information and teaching activities that help students understand the connections that maintain ecosystems.

Preparing for Tomorrow's World: Decisions for Today and Tomorrow.
Louis Iozzi and Peter Bastardo, 1987. Available from Sopris West Inc., 1140 Boston Avenue, Longmont, Colorado, 80501.

> A series of Science-Technology-Society modules that focus on issues such as nuclear energy, genetic engineering, acid rain, and hazardous waste. Issues are presented with background readings, questioning strategies, and case studies.

Sustainable Economics: A Supplementary Curriculum for High School Economics Courses.
The Center for Economic Conversion, 222 View Street, Suite C, Mountain View, California 94041-1344. (415) 968-8798.

> *Sustainable Economics* presents an introduction to a variety of economic systems and includes a critical analysis of contemporary industrial-capitalism. Written by San Francisco Bay Area high school economics teachers, *Sustainable Economics* includes five lesson plans and eleven activities which focus on contemporary, relevant topics for discussion.

Taking Sides: Clashing Views on Controversial Environmental Issues, and Instructor's Manual for Taking Sides: Clashing Views on Controversial Environmental Issues.

Theodore D. Goldfarb. Available from Dushkin Publishing Group,
Sluice Dock, Guildford, Connecticut 06437. (800) 243-6532.

> *Taking Sides* presents two opposing points of view on a series of eighteen controversial environmental issues such as reauthorization of the Endangered Species Act, the need for widespread use of pesticides to feed an increasing world population, and the need for aggressive international efforts to slow global warming. The Instructor's Manual includes a synopsis of each author's position on the issue, teaching suggestions, and multiple-choice and essay questions. The teaching hints consist of suggestions for generating class discussion around the themes raised by the clashing essays.

Training Student Organizers Curriculum.

Zamm, Michael, Robert Ortner, and Beverly DeAngelis, 1990.
Available from the Council on the Environment of New York City,
51 Chambers Street, Room 228, New York, New York 10007.
(212) 788-7900.

> The curriculum shows teachers, youth leaders, and community activists how to organize environmental improvement projects in neighborhoods, schools, and homes. It contains step-by-step lesson plans for organizing anti-litter campaigns, recycling programs, energy conservation programs, open space projects and many others.

Tropical Forests.
Population.
Biological Diversity.
Consider the Connection.
Citizen's Guide to Global Issues *(background information).*

Global Tomorrow Coalition, 1325 G Street NW, Suite 915, Washington
D.C. 20005.

> Global Tomorrow Coalition is publishing a series of packets for teachers–background information, activity ideas, and handouts on environmental issues of global significance.

Understanding the Game of the Environment: An Illustrated Guide to Understanding Ecological Principles.
(Agricultural Information Bulletin No. 426)
David R. Houston, 1979. US Forest Service, US Department of Agriculture, Washington D.C.

Here is an ecological text published for high school students. Major ecological principles are summarized and organized into a game, complete with players, rules, boundaries, etc. Detailed illustrations provide the basis for in-depth discussions.

Appendix A-2: Select Examples for Your EE Library

Resource Books in Education and Environmental Issues

The Cousteau Almanac: An Inventory of Life on our Water Planet.
Jacques Ives Cousteau and Cousteau Staff, 1981. Doubleday Company, New York.

The *Almanac* is a treasure of information on environmental issues around the world in the 1980's. Articles are superbly written, well documented, and arranged in an unique order. Scattered throughout are vignettes of people and organizations who work toward the solutions to environmental problems, usually on a local level, and usually successful. The last section provides information on organizing around an issue and taking action.

Environmental Science: An Introduction, 1988 *(second edition)*.
Living in the Environment: An Introduction to Environmental Science, 1990 *(fourth edition)*.
G.Tyler Miller. Wadsworth Publishing Company, Belmont, California, 1986.

Both texts fairly represent the variety of perspectives that color environmental issues. *Environmental Science* covers the issues in less depth than *Living in the Environment*. Written for the college student.

Environmental Issues Forum (EIF).
North American Association for Environmental Education, P.O. Box 400, Troy, Ohio 45373.

The EIF is a program with a series of booklets providing background information on, and initiating discussion of, current environmental issues. Two EIF books are currently avilable: "The Solid Waste Mess: What Should We Do With Our Garbage?" and "The Wetlands Issue: What Should We Do With our Bogs, Swamps, and Marshes?" A "Moderator's Guide" is also available to help you set up, publicize, and run a forum or study circle.

Environmental Science: A Framework for Decision Making.
Daniel D. Chiras, 1985. The Benjamin/Cummings Publishing Company, Inc., Menlo Park, California.

This text presents a current, comprehensive, and holistic overview of critical environmental issues useful to readers with little or no background in science. Written for the college student.

The Environment Source Book.
Sources Annuals.
Greenhaven Press, P.O. Box 289009, San Diego California 92198, (800) 231-5163.

A compilation of brief articles arguing environmental issues from across the political spectrum. Several articles on each of 14 topics; authors from William Buckley to Jeremy Rifkin.

The Global Citizen.
Donella Meadows, 1991. Island Press, Washington, D.C.

The Global Citizen is a collection of over 80 newspaper articles written by Meadows for her syndicated column, Global Citizen. In simple and eloquent language, she discusses the global environment, the beauty of nature, the treasure of simplicity, the successes happening, and the hopeful solutions that lie ahead.

The Global Ecology Handbook.
The Global Tomorrow Coalition, 1990. Beacon Press, 25 Beacon St. Boston, Massachusetts 02108-2800.

This handbook, a practical supplement to the PBS series *Race to Save the Planet*, is designed to help overcome the political, social, and economic obstacles that continue to retard progress toward solutions to environmental problems. Among other things the Handbook: provides basic facts about global population, resource, and environmental problems; demonstrates how these problems are interrelated; shows how the problems affect the lives of citizens in the United States and other countries; suggests how individuals and groups can participate in acheiving solutions.

A Guide on Environmental Values Education.
Michael Caduto. UNESCO, Paris France, 1985. Available from Michael Caduto, P.O. Box 1052, Norwich, Vermont 05055.

This slim, well-written manual includes background and theory on attitude formation, moral development, values clarification, and other valuing strategies. Two chapters describe environmental values activities for younger and older students that should contribute to their moral development.

The Handbook of Nature Study.
Anna Botsford Comstock, 1939, 1967, 1974. Cornell University Press, Ithaca, New York.

> This classic reference was first published in 1911 from the stronghold of the natural history movement. It is still one of the best sources of natural history information and tidbits available. Comstock's observations of animal behavior are thorough and delightful to read.

State of the World (published annually)
Lester Brown, et al. W.W. Norton, New York. Available from Worldwatch Institute, 1776 Massachusetts Avenue NW, Washington, DC 20036.

> The tenth volume in a series, this annual report produced by the Worldwatch Institute is an invaluable resource of up-to-date information on the environment.

World Resources 1992-93 (Updated annually).
Teacher's Guide to World Resources 1992-93: Comprehensive Coursework on the Global Environment.
World Resources Institute. 1709 New York Avenue, NW, Washington, DC 20006, (202) 638-6300.

> Activities, graphs, and information in this booklet enhance the global data available in World Resources 92-93. Teachers can use these units on wetlands, biodiversity, etc., to develop a secondary course or unit.

The Wholeschool Book: Teaching and Learning Late in the 20th Century.
Bob Samples, Cheryl Charles, and Dick Barnhart, 1977. Addison-Wesley Publishing Company, Reading, Massachusetts.

> This book offers a humanistic, people-oriented philosophy of education complete with suggestions for questions, discussions, and activities that encourage students to participate in the learning process.

Academic/Professional Work in Environmental Education

The Journal of Environmental Education
Heldref Publications, 1319 18th Street, NW, Washington, DC 20036.
(800) 365-9753

The Environmental Communicator
NAAEE, P.O. Box 400, Troy Ohio 45373.
(513) 676-2514

NAPEC Quarterly
National Association of Professional Environmental Communicators
P.O. Box 61-8352
Chicago, IL 60661-8352

Periodicals for Teachers and Students

Ranger Rick, National Wildlife,* and *International Wildlife
National Wildlife Federation
8925 Leesburg Pike
Vienna, VA 22184-2266
(703) 790-4482

National Geographic World
National Geographic Society
17th and M Street NW
Washington D.C. 20036
(202) 857-7000

Owl* and *Chickadee
The Young Naturalist Foundation
56 The Esplanade, Suite 306
Toronto, Ontario, M5E 1A7,
Canada.
(416) 868-6001

World Watch Papers
Worldwatch
Worldwatch Institute
1776 Massachusetts Ave. NW
Washington D.C. 20036
(202) 452-1999

The Amicus Journal
National Resources Defense Council
40 W. 20th Street
New York, NY 10011
(212) 727-2700

EE News: Environmental Education in Wisconsin
WI Department of Natural Resources
Box 7921
Madison, WI 53707-7921

Audubon
National Audubon Society
700 Broadway
New York, NY 10003
(212) 979-3000

Sierra Magazine
The Sierra Club
730 Polk Street
San Francisco, CA 94109
(415) 776-2211

Green Teacher
95 Robert Street
Toronto, Ontario M5S 2K5
Canada

Environmental Action
Environmental Action
6930 Carroll Avenue, Suite 600
Takoma Park, MD 20912
(301) 891-1100

The Nature Conservancy
The Nature Conservancy
1815 N. Lynn Street
Arlington, Virginia 22209
(800) 628-6860

Buzzworm
Buzzworm, Inc.
2305 Canyon Boulevard
Suite 206
Boulder, CO 80302
(303) 442-1969

P-3, The Earth Based Magazine for Kids
P.O. Box 52
Montgomery VT 05470
(802) 326-4669

Garbage
Old House Journal
P.O. Box 56519
Boulder, CO 80322
(800) 274-9909

E: The Environmental Magazine
Subscription Department
P.O. Box 6667
Syracuse, NY 13217
(800) 825-0061

Clearing
Creative Educational Networks
John Inskeep Environmental
Learning Center
19600 S. Moalla Avenue
Oregon City, OR 97045

Science Scope

The Science Teacher

Science and Children
National Science Teachers
Association
1840 Wilson Blvd.
Arlington, VA 22201-3000

We Want Your Feedback!

Your feedback can help us make "Getting Started" as useful as possible. Please take a moment to fill out postage-paid form on the adjoining page to help us help others *get started!*

Thank you for your comments!

Detach here, then turn over, fold, tape, and send!

General Feedback

How useful did you find the following sections of "Getting Started"?
(1=least useful; 5=most useful)

1	2	3	4	5	Profiles of teachers
1	2	3	4	5	Description of how to get started
1	2	3	4	5	Where to look for materials
1	2	3	4	5	Locating financial support
1	2	3	4	5	Addresses of organizations
1	2	3	4	5	List of selected instructional materials

Feedback on Stories

Which ***one*** statement most accurately describes you:

__ I read only the stories that followed the chapter I was interested in

__ I read only the stories relating to my grade or subject area

__ I did not read any of the stories. I read only the informational portions of "Getting Started"

What made some stories more interesting than others?

Did any of the stories...

...give you a new idea that you have done or plan to do with your students? ___Yes ___No; If yes, which ones?

...give you ideas on how to involve other teachers in your school in EE? ___Yes ___ No; If yes, which ones?

...give you ideas on where to find funding for your EE efforts? ___Yes ___ No; If yes, which ones?

...give you ideas on where to find other educators in your area/state/region interested in EE? ___Yes ___ No; If yes, which ones?

...motivate you to attend an EE workshop? ___Yes ___ No; If yes, which ones?

Other:

Did you contact any of the teachers profiled in "Getting Started"?
__ Yes __ No

If so, was the contact helpful? ___ Yes ___ No

If so, how? (check all that apply)

__ Provided information I can use in my classroom

__ Shared ideas/suggestions

__ Provided names of other organizations to contact

Other:

Feedback on Information

Did you contact any of the groups listed in "Getting Started?"
__ Yes __ No

If so, was the contact helpful? __ Yes __ No

If so, how? (check all that apply)

__ Provided information I can use in my classroom

__ Shared ideas/suggestions

__ Provided names of other organizations to contact

Other:

Your Profession

__ Teacher (circle one): [Lower El / Upper El / MS / HS / Other]

Subject(s) taught:

__ School Administrator

__ Natural Resource Professional

Other:

Your level of familiarity with EE in the classroom

__ Have never done EE in my classroom

__ Have occasionally incorporated an EE activity into my classroom/course

__ Have designed and taught an entire unit on the environment in my classroom

__ Have integrated EE into my entire classroom/course

Other:

How did you find out about "Getting Started?"
Put an "X" in front of each that applies:

__ From a colleague

__ At an Environmental Education workshop

__ My State's Department of Education EE Office

__ Regional EPA EE Office

__ A State EE association/organization

__ A newsletter or magazine? Which one?

Other:

Do you know a teacher or administrator who has done wonderful things in Environmental Education that we should include in the next "Getting Started?"

Your name:
Teacher or Administrator's name:
School:
Telephone number:
Address:

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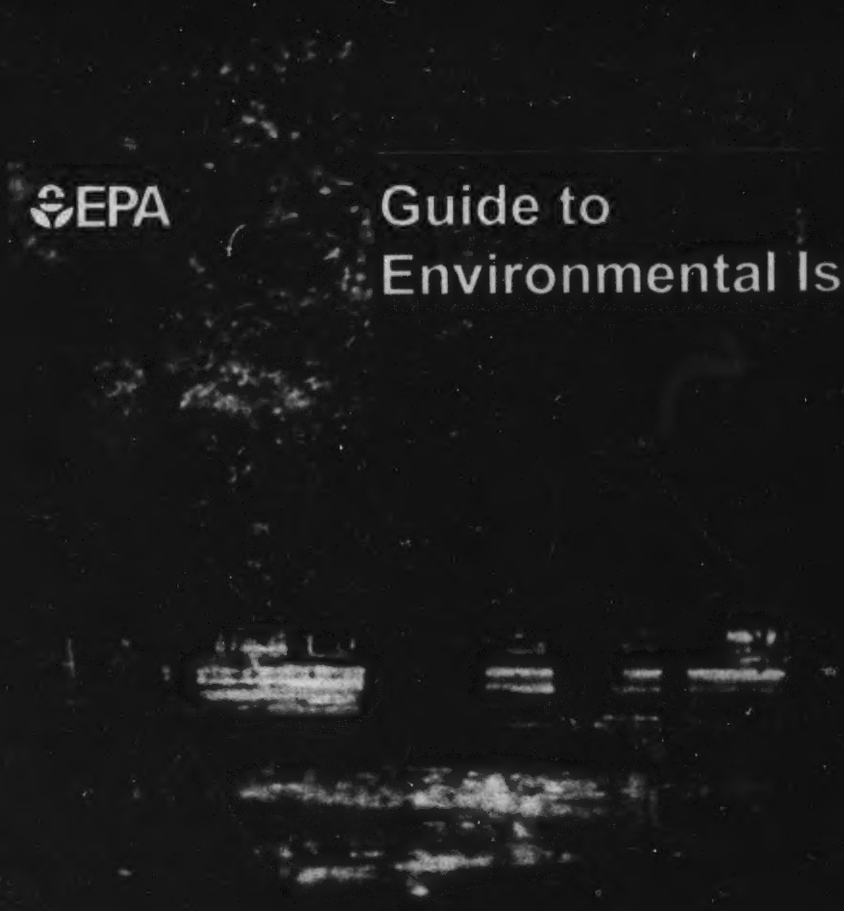
The printing is donated by Amway Corporation, Ada, Michigan. The material for this publication consists of 25% recycled Amway office waste.

EPA

ISBN 1-884782-00-0

EPA

Guide to Environmental Issues



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Guide to Environmental Issues

Earth Day 25 Edition
April 22, 1995

Office of Solid Waste &
Emergency Response

Project Manager and Editor:
Julie Klaas Pangman

Cover photo: Bottomland Hardwoods, Yazoo National Wildlife Refuge, Mississippi, courtesy U.S. Fish & Wildlife Service.

This ***Guide To Environmental Issues*** was based in concept and format on *Citizens' Guide for Environmental Issues - A Handbook for Cultivating Dialogue* by the National Institute for Chemical Studies and U.S. EPA, 1989 and 1990.

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Note: **Bold face** terms used throughout are defined in the Glossary, Laws Section, or Government Agencies Section.

information sources

Although protective laws respond to public needs, we need to understand how laws and regulations work in real situations. Knowing where to turn for help is sometimes as difficult as understanding which issues are addressed by specific environmental laws.

introduction

By choosing to read this Guide, you are showing your concern for the environment. Many of our daily activities can potentially alter environmental balances, but too often we ignore relationships among people, other living creatures, and our surroundings.

Environmental protection can be most effective when complex connections between all parts of an **ecosystem** and society are taken into account. No longer can we say, *"I'm too busy to be concerned with the environment—someone else can take care of it."*

citizen participation

That someone is you. Citizen participation is a key element in environmental protection. This Guide is dedicated to the enthusiastic interest and creative ideas of people across the country who are concerned about the nation's environmental health. Diverse elements of everyday life make each contribution unique. The abilities and vision of a multitude of people need to be applied to the public decision-making process.

This handbook lists federal and state agencies as well as pertinent health, safety, and environmental laws, with brief comments on each law's intent.

the terminology problem

Discussing complex economic, technical, health, safety, and environmental issues can be frustrating. Many environmental conversations evolve into a series of acronyms, technical terms, and jargon that can leave you confused unless you have been previously involved with the issues. When words or phrases remain undefined, dialogue is likely to be limited. With *Guide to the EPA*, we try to make environmental concepts clear to all so that language and limited access to information do not hinder public participation.

When you see a term in **bold**, that word is defined in the Glossary in the back or may refer to a specific Law or Government Agency. We included terms and definitions relating to **pollution prevention**, enforcement, regulations, community involvement, and environmental **risk**. We also included a variety of technical terms and acronyms frequently used by subject matter specialists.

Please note that many terms in the text and glossary may have different meanings for different audiences. Definitions and explanations presented here provide only a general understanding of the terminology and should not be taken as full technical or legal definitions. Although much more could be said about any topic, the information provides the basics in non-bureaucratic English. We hope this Guide helps you become actively involved in community dialogue and better able to understand environmental issues.

where do I get help?

Have you ever wondered where to turn for answers to environmental problems? If so, you are not alone. In the back of this Guide we have listed four pages of EPA and federal agency telephone numbers and addresses, followed by two pages of **Hotlines** that EPA maintains for general and specific information. But protection of the environment is a big job. Federal, state, and local agencies across the nation are all involved, employing thousands of citizens who care about their health and natural resources. Every city, county, and state networks with federal groups to share and provide information. If the first person you contact can't answer a specific question, he or she will know who can.

Civic and community organizations are usually helpful too. Chances are, if you contact one group that is not involved with a particular topic, you will be steered to the correct organization. In some areas, environmental and other community groups have formed coalitions for improved communications and action on specific issues.

The literally thousands of trade and citizen groups involved in environmental issues are far too numerous to list. Your local telephone Yellow Pages contains a directory of many groups and their respective telephone numbers. You should contact those groups whose interests are similar to yours.

pollution prevention

One of the most encouraging environmental developments of recent years is the trend toward preventing — and not just treating — **pollution.** For example, scientists have found various ways to treat wastes in order to protect the environment. Now, there is growing realization that whenever possible, avoiding wastes altogether is even better.

On a broad level, passage of several laws relating to the environment helped create a climate of change. **The Clean Air Act (CAA)** in 1970 and the **Clean Water Act (CWA)** in 1972 signalled our nation's intent to address **pollution.** Many activities and programs have followed these Acts to limit further the amounts of allowable **discharges** into the environment. We now recognize that end-of-pipe technology offers only a partial solution and fails to completely protect the environment.

The **Pollution Prevention Act of 1990** takes a new approach. To avoid pollution in the first place, manufacturers are encouraged to modify equipment and processes, redesign products, substitute raw materials, and make improvements in management techniques, training, and inventory control.

Here's one example. The **U.S. Environmental Protection Agency (EPA)** is responsible for protecting people and the environment from **risks** associated with all sorts of toxic chemicals.

One of the best ways to accomplish this is through **pollution prevention**. Before a new chemical is marketed, EPA reviews the ingredients and intended uses to determine potential health or environmental hazards. During the review, EPA identifies measures aimed at reducing exposures to the chemical. At this early stage, companies wanting to manufacture or use the chemical can readily integrate pollution prevention measures into their plans. If such measures will not reduce potential risks, EPA can regulate the chemical in several other ways.

EPA also reviews chemicals already in production. The **Toxic Substances Control Act (TSCA)** Inventory lists about 70,000 existing chemicals. Of greatest concern are 10,000 to 14,000 high-volume chemicals for which little or no data exist. To address this large number of chemicals, EPA systematically reviews clusters of related chemicals and ranks them for further review or testing. Nominations of candidates for screening come from a variety of sources, including a federal interagency testing committee of experts.

Pollution prevention also involves waste **minimization** — **recycling** what we used to throw away or not generating wastes in the first place. Many companies now are cleaning up solvents for re-use or changing the industrial process to more efficiently use raw materials. Likewise, scientists are developing new technologies every year to eliminate or greatly reduce our dependence on **toxic substances.** A simple example is using hot water and soap instead of organic solvents to clean equipment.

energy

EPA POLLUTION PREVENTER

Preventing pollution can save money in a variety of ways, and so EPA has designed several non-regulatory, innovative pollution prevention programs. Corporations, environmental groups, electric utilities, and state, city, and local governments participate voluntarily in the following:

The "33/50" Program focuses on reducing overall **risk** from 17 high-priority toxic chemicals. The name derives from voluntary performance goals: participating companies pledged to reduce **emissions** and transfers of these chemicals by 33% in 1992 and 50% by 1995. The 1992 goals were surpassed a year ahead of schedule — more than 486 million pounds of reductions were achieved, due to conscientious business practices.

Through the "Design for the Environment" Program, EPA is working with specific industries to find chemical substitutes and **exposure** reduction techniques. The printing and drycleaning industries are currently piloting a voluntary shift toward using more environmentally safe chemicals and technologies. More information is available at 202/260-1821.

Six "Energy STAR" programs seek to prevent emissions of air pollutants associated with **climate change** and **acid rain**, while promoting profitable investments in energy-efficient technologies. Information about all "Energy STAR" programs is available from 202/233-9659. You can request specific documents to be mailed or sent by facsimile. A handy set of directions walks you through program selections on your telephone.

In a nutshell, the "Green Lights" program encourages the widespread use of energy-saving light bulbs and fluorescent tubes. "Green Lights" participants are already avoiding over 95 million kilowatts annually — that equals $9.4 million in avoided electricity costs.

The "Energy STAR Buildings" program is a partnership effort with business to promote energy efficiency in commercial buildings. The program starts with membership in "Green Lights," followed by a comprehensive building survey and tune-up. The program then engineers increased efficiency in heating, ventilation, and air conditioning loads and improved fans and air-handling systems.

"Energy STAR Computers" is another partnership with leading U.S. manufacturers to save additional energy costs. Desktop computers, monitors, and printers can "sleep" or "power down" when not in use, cutting electricity use by over one-half. The federal government, the largest user of computer equipment in the world, will buy only energy-efficient computers in the future.

The "Ag STAR" Program focuses on animal waste methane which is emitted to the air when manures ferment. Such emissions waste a usable energy supply, produce odors, and contribute to **climate change**. This innovative program recovers methane gas from swine and dairy manure for re-use by the farmer.

The "Natural Gas STAR" program is another methane recovery project aimed at oil and natural gas pipeline leakages and system inefficiencies. EPA is working with public utility commissions to reform rate structures to include incentives for efficiency gains, cost reductions, and methane emissions reductions.

The "Super Efficient Refrigerator Program" seeks to produce energy-wise appliances for home and commercial use. **Chlorofluorocarbons (CFCs)**, chemicals used in refrigerators for cooling and freezing, are **ozone**-depleting substances that will be phased out of production by 1995. This program is finding alternative coolants and optimizing energy efficiency through better compressors, door seals, and insulation.

In addition, EPA has many other new voluntary programs, some just getting off the ground, but these three top the list:

The "Climate-Wise" Program challenges organizations from all sectors of the economy to find creative ways to limit or reduce greenhouse gas emissions (see **climate change** in the Glossary). Such actions may include raw material substitution, process improvements, and switching to lower-carbon-content fuels. Other initiatives put into place employee's good ideas: planting more trees, grasses, and plants to absorb excess carbon dioxide from the air, carpooling, and installing corporate-wide efforts to recycle and reduce waste. For more information, call 202/260-4407.

The "Waste-Wise" Program is a public-private partnership designed to assist businesses in reducing their solid waste. Businesses set their own goals and commit to achievements in the following three areas: waste prevention, recycling collection, and buying or manufacturing recycled products. Additional information is available by calling 800/ EPA-WISE.

Last, but not least, is the "Water Alliance for Voluntary Efficiency" Program, called WAVE. Designed to focus attention on efficient use of water, WAVE encourages hotels and motels to install water-saving

EPA
Green
Lights

wave
Water Alliances for Voluntary Efficiency
EPA

devices. Use of low-flush toilets, and low-flow shower heads, dishwashers, and laundry equipment, as well as **recycling** wastewater, is both profitable and practical. The payback period for most projects is three years or less. This program will be expanded to more businesses, institutions, and local governments. For more information, call 202/260-7288.

The same basic pollution prevention ideas can be used in the home. Each of us can use energy efficient or recyclable products and decrease our volume of waste. Contact agencies listed in the Directory of this Guide for things you can do to prevent pollution. In addition, bookstores and libraries typically contain information that can help you and your family dramatically reduce — and in some cases eliminate altogether — everyday sources of pollution. As our awareness grows and we begin to realize the full health and environmental effects our actions have, pollution prevention becomes increasingly attractive.

some questions & answers on pollution prevention

Q. *How does pollution prevention work?*

A. Here's an example. If a chemical has been identified as toxic to the environment and a less harmful substance is used instead, pollution may be prevented. By the same token, your conscientious selection of products for the home can prevent pollution.

Q. *Why wasn't pollution prevention started sooner?*

A. During the industrial revolution, few people envisioned what an enormous collective effect we would have on the global environment. We chose first to treat the obvious effects of pollution, not the sources.

Q. *What are some specific ways I can personally prevent pollution?*

A. Look for goods with less packaging, use longer-lasting, full-spectrum fluorescent tubes that require only a fraction of the energy of incandescent bulbs; reduce your use of hazardous household products; recycle glass, paper, plastic, cardboard, and other materials. Many other ideas are available from EPA, environmental groups, and trade associations.

Q. *Where can I get more information on pollution prevention?*

A. Call EPA's Pollution Prevention Office at 202/260-1023. Many states also have pollution prevention offices with information available to the public.

address these and other chronic air quality problems.

These Amendments signal a change from past pollution control approaches. Innovations in this law include programs based on cooperation between government and industry, and

air & radiation

Perhaps more than anything else, air interacts directly and constantly with us. All land creatures breathe gases and materials suspended in the air. By the same token, trees, grasses and other plant species carpeting the earth are equally dependent on clean air. We all have a stake in the quality of our air.

Outdoor air quality is affected by many human and natural activities. Manufacturing companies, power plants, small businesses, automobiles, forest fires, and volcanoes are all sources of air pollution. Any activity that releases materials into the air affects air quality.

Although the landmark 1970 **Clean Air Act (CAA)** prompted large improvements in air quality, not all of Congress' goals have been met. Emissions of pollutants such as sulfur oxides, **volatile organic compounds (VOCs)**, carbon monoxide, particulates, and lead have been greatly reduced. But much work remains to effectively reduce acid rain, **smog**, and air toxics associated with increased cancer risk and other health complaints. The 1990 CAA Amendments were intended to **pollution prevention** incentives based on market forces. The goal of the entire Act is to reduce air pollution by 56 billion pounds per year. These reductions are expected to come from cutting **emissions** from several major as well as many minor sources.

Urban pollution also is addressed under the 1990 CAA Amendments. Cities that fail to meet standards for human health must comply with the standards by deadlines set in the law. In many urban areas, ground level **ozone** persists in **concentrations** harmful to human health. Large sources of pollutants (such as nitrogen oxides) that contribute to this problem and smaller sources of **hydrocarbons** must reduce emissions. In some cities, this requires vehicle emissions testing, **vapor recovery systems** at gas stations, and other controls on smaller sources of pollution.

Carbon monoxide problems in **non-attainment** areas are addressed in a similar fashion. Areas with the worst carbon monoxide problems are required to use special forms of gasoline known as oxyfuels during winter months.

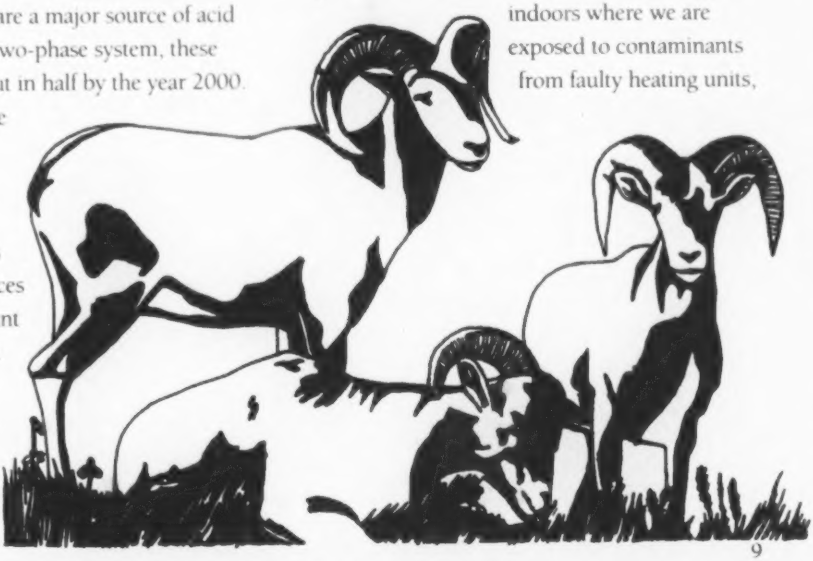
Other areas that fail to attain standards for **particulate** matter may be required to limit the use of wood stoves and fireplaces and to impose stiffer controls on industry.

In addition, emissions of 189 air toxics must be reduced by the turn of the century. EPA has published a list of source categories for which **Maximum Achievable Control Technology (MACT)** is being developed. Companies that achieve reductions of emissions before the regulations are proposed can receive six-year extensions to comply with the standard. EPA has estimated that overall health risks, including risk of cancer, respiratory disease, heart ailments, and reproductive disorders, will decline significantly once MACT controls are installed.

The CAA Amendments also look beyond the U.S. to reduce **acid rain** and address loss of stratospheric ozone. Sulfur dioxide emissions from power plants are a major source of acid rain. Under a new two-phase system, these emissions will be cut in half by the year 2000. Power plants will be issued emission allowances which can be banked or traded. If emissions exceed the allowances held, the power plant must pay a penalty. The CAA Amendments also restrict the use, emission, and disposal of ozone-depleting chemicals such as chlorofluorocarbons (**CFCs**, also known as Freons) and other chlorine- and bromine-containing compounds. CFCs are commonly used in refrigerators and air conditioners.

Working in consultation with state and local governments, EPA bears primary responsibility for this sweeping legislation. EPA's Office of Air and Radiation is the lead office for developing the scores of regulations required under the Act. States also share responsibility for issuing and enforcing air pollution **permits**. In some areas, local governments will test vehicle emissions and monitor other air quality issues.

Indoor air is often more polluted than the air outside our homes and workplaces. This has been shown to be true across the country, even in neighborhoods without heavy industrial **pollution**. More than 90% of our time is spent indoors where we are exposed to contaminants from faulty heating units,



gas stoves, fireplaces, cleaners, solvents, cosmetics, cigarette smoke, wall coverings, paints, and improperly stored chemical products.

Another significant indoor health hazard results from **radon** gas, which in many areas of the country seeps from the earth into homes. There are several ways to check and safeguard your home, with proper ventilation being one of the simplest. Radon test kits are available from a variety of sources including hardware stores, health departments, and environmental agencies.

In your home, make sure that gasoline cans for lawn mowers have securely fitted lids. These items as well as household hazardous chemicals should be stored outside the home when possible. Dispose of unwanted or unused solvents and **pesticides** properly. Some stores that sell these items will dispose of them for you. In many states, environmental agencies in cooperation with industries have sponsored "Household Hazardous Waste Days" during which citizens may take paint, solvents, and other wastes to local collection sites for proper disposal.

The quality of indoor air is largely up to individuals and businesses. Although safe working conditions are mandated by the **Occupational Safety and Health Administration (OSHA)**, no agency forces homeowners to provide clean indoor air. You must take steps on your own to improve the quality of indoor air in your home.

some questions & answers about air quality

Q. *Whom do I call to report visible* ***emissions*** *or noxious odors in the air?*

A. Generally, your state or local air quality office should be contacted. For emergencies, dial 911 or your local fire department or public health agency. Be aware that visible **emissions** are not necessarily the most harmful; most emissions are colorless or odorless.

Q. *Who monitors the required reports of toxic air emissions and safety measures used to control those emissions?*

A. EPA, your state air quality office, the **State Emergency Response Commission (SERC)**, and your **Local Emergency Planning Committee (LEPC)** monitor these reports.

Q. *Who sets the legal air exposure limits for toxic chemicals?*

A. EPA sets the standards for outside (**ambient**) air, OSHA for the workplace.

Q. *What is Best Available Control Technology? What is MACT?*

A. **Best Available Control Technology** (**BACT**) refers to the best equipment, techniques, or mechanisms that are currently available to achieve a level of pollution control. Through research, technology may be available in the future to achieve even better controls. **MACT** is **Maximum Achievable Control Technology** and refers to the maximum degree of pollution reduction obtainable.

Q. *What happens to toxic airborne* **emissions** *when they are released from chemical plants, automobiles, or power plants? Do they change into other toxics when they mix? Where are they finally deposited?*

A. We are only beginning to find out what happens to emissions. Little is known about the interaction of chemicals in **ambient** air, but some effects such as **smog**, **ozone** depletion, **acid rain**, and **climate change** are a few of the known consequences when air emissions interact, are blown by the wind, and are deposited in cities, fields, and **wetlands**. These effects have generated new research to find answers.

Q. *Do weather conditions affect pollution and the dispersion of airborne chemicals?*

A. Yes. Weather conditions—including temperature, sunlight, precipitation, and wind—play a major role in how vapors and suspended particles behave. Sunlight can destroy or alter some airborne chemicals. Rain, snow, and wind affect where and when air pollutants are deposited on land or water.

Q. *Are incinerators a source of toxic emissions to the air?*

A. Well-designed, well-constructed, and well-operated **incinerators** can nearly eliminate toxic emissions to the air. To receive a **permit** to operate, a hazardous waste incinerator must demonstrate 99.99% efficiency in destroying most **hazardous wastes**. The standard is even stricter for dioxins and PCBs.

Q. *How does eliminating toxic wastes at the source of production differ from utilizing best available control technology (BACT)?*

A. Basically, at-source control is a **pollution prevention** approach that seeks to keep hazardous wastes from being produced. BACT, on the other hand, is the best technology for treating, containing, or reducing discharges and emissions.

surface water

Although the vast majority of the earth's surface is covered with water, the oceans and seas are salty. Only 3% is fresh — and two-thirds of that is ice! This tiny fraction of fresh water sustains a multitude of very specific life forms, including our own. While many people get their drinking water from underground reserves, **surface waters** also are an important source. In addition, lakes, rivers, and streams provide boating, swimming, fishing, and other forms of recreation.

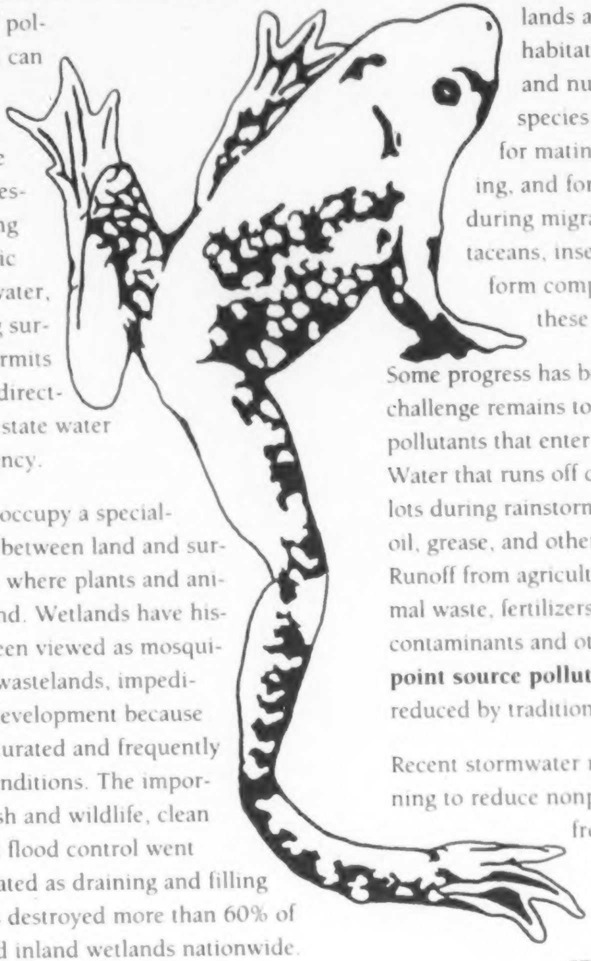
The economic support offered by plentiful and high quality surface waters includes agricultural irrigation, process and cooling waters for power plants, and chemical, steel, lumber, mining, and other industrial operations. The eastern U.S. has a bountiful supply of this natural resource, while in the western states, the relative scarcity of surface water serves to increase its value. In all parts of the country, however, we need to use our water efficiently. Using less water reduces the amount of wastes discharged into our lakes, streams, rivers, and oceans, as well as the energy needed to treat wastewater.

The cornerstone for protecting this valuable resource and controlling water pollution was the Federal Water Pollution Control Act of 1972. In 1977, the Act was reauthorized and renamed the **Clean Water Act (CWA)**. The goal of the CWA is the "restoration and maintenance of the chemical, physical and biological integrity of the Nation's waters." Under this Act, it is illegal to **discharge** pollutants from a **point source** into any surface water without a **National Pollution Discharge Elimination System (NPDES) permit**. **EPA** has the authority to set standards for the quality of wastewater discharges. Amendments to the CWA in 1987 increased the ability of EPA and states to improve water quality by addressing toxic discharges, allowing citizen lawsuits, and funding municipal sewage treatment facilities.

Most states have legal authority to implement and enforce the provisions of the Clean Water Act, while EPA retains oversight responsibilities for most state water programs. **Water quality standards**, criteria to assure that streams are "fishable and swimmable," are set by each state, with

EPA oversight and approval. State water pollution control agencies and EPA use these standards to set limits on the amounts of pollutants that can be discharged into surface waters. Questions dealing with specific bodies of water, monitoring surveys, or permits should be directed to your state water quality agency.

Wetlands occupy a specialized niche between land and surface water, where plants and animals abound. Wetlands have historically been viewed as mosquito-ridden wastelands, impediments to development because of their saturated and frequently flooded conditions. The importance to fish and wildlife, clean water, and flood control went unappreciated as draining and filling operations destroyed more than 60% of coastal and inland wetlands nationwide. Discharges from industries, midnight dumping of toxic wastes, urban runoff, **acid rain**, and agricultural chemicals have polluted and degraded wetlands as well.



Wet meadows, prairie potholes, wooded swamps, and coastal, saltwater marshes are distinctly different. But all wetlands are important wildlife habitats, breeding grounds, and nurseries. Hundreds of species of birds use wetlands for mating, nesting, brood-rearing, and for resting and feeding during migration. Fish, crustaceans, insects, and other animals form complex food chains in these valuable ecosystems.

Some progress has been made, but a major challenge remains to reduce and control pollutants that enter all surface waters. Water that runs off city streets and parking lots during rainstorms may contain metals, oil, grease, and other automotive fluids. Runoff from agricultural fields contains animal waste, fertilizers, and **pesticides**. These contaminants and others are called **nonpoint source pollution** and cannot be reduced by traditional end-of-pipe controls.

Recent stormwater regulations are beginning to reduce nonpoint source pollution from industries and cities. Farming practices that emphasize soil conservation and appropriate use of pesticides are effective in reducing pollutants in runoff. You can help prevent nonpoint source pollution by properly disposing of used motor oil, using fewer pesticides, and carefully assessing lawn and garden practices. By reducing the potential contaminants we place on streets, driveways and lawns, we can make a substantial contribution to improving the quality of rivers, streams, lakes, and wetlands.

some questions & answers on surface water

Q. *Where can I get information about the water quality of streams, lakes, wetlands, and other bodies of water in my state?*

A. State water quality agencies, in general, maintain records of water quality for many state surface waters. General information about water quality is available through the state agency information offices, EPA, and many citizen groups. EPA maintains an Office of Water Resource Center to answer general questions about standards and water quality. The telephone number is 202/260-7786.

Q. *How are water quality standards developed for U.S. surface waters?*

A. EPA develops water quality **criteria** that indicate **concentrations** of contaminants that are not expected to harm human health and aquatic life. States may use these criteria to set water quality standards or they may develop their own standards that address state-specific needs, are scientifically defensible, and as stringent as the national criteria. States are required to review water quality standards every three years. New information from EPA, industry, or any other group concerning safe levels of materials in surface water may be considered, and existing standards may be revised to reflect current scientific developments. Notices of proposed revisions are published in newspapers to encourage the public to participate in the revision process. State standards must be approved by EPA.

Q. *How can I find out what materials are being discharged into local bodies of water?*

A. By submitting a request to the water pollution control agency in your state, you can review the National Pollutant Discharge Elimination System (NPDES) permits for specific dischargers into surface water. New permits and renewals of existing permits are published in local papers with information on how to review the permit application. State and federal agencies, including EPA's Office of Water and the **U.S. Geological Survey**, compile stream-specific water quality data in various reports available to the public.

Q. *What can I do if I think that an NPDES permit should not be issued or that the requirements of the permit are inadequate?*

A. Anyone may comment on the issuance or reissuance of an NPDES permit within the period listed in the public notice. The permit-issuing agency must respond to public comments before granting the permit. Most states have a process by which affected citizens and companies may appeal the terms and conditions of a NPDES permit or who receives one.

Q. *Whom do I contact if I see a spill or notice unusual conditions such as color, odor, or fish kills in a stream, lake, estuary, or coastal area?*

A. First contact your city or county public health department or check to see if your state has a toll-free **pollution** hotline. Any spill should be reported immediately to the **National Response Center** at **1-800-424-8802**. For other complaints and concerns about water quality, call your state agency representatives during normal business hours and ask for an investigation.

ground water

The nation's **ground water** resources are extremely valuable. Half of all Americans and more than 95% of our rural population get their household water supplies from underground sources. Ground water also is used for about half of all agricultural irrigation and a third of industrial water needs. In many places, this vital resource is already contaminated or threatened.

Even more than **surface waters**, ground water resources are often taken for granted because they are not visible. Rainfall and surface water which had seeped into the earth's crust over many years formed underground reservoirs. Where the **water table** is at or close to the surface, ground water enters **wetlands**, lakes, rivers, and streams and provides a base flow during dry periods. By comparison to rivers and streams, ground water moves very slowly and with little turbulence. Therefore, once contamination reaches ground water, little dilution or mixing occurs. While wells and springs in many parts of the country are abundant and supply good quality water, contamination in other areas may be severe but undetected until the ground water is used.

Activities to protect ground water are guided by several different federal and state laws and are conducted by a number of different agencies. Some states have comprehensive ground water protection statutes, but all states have some authority to protect ground water under solid and hazardous waste laws, public health laws, and energy extraction laws. Regulatory authority and information about ground water quantity and quality vary among state agencies, but usually reside in natural resources, environmental protection, or public health agencies.

Ground water issues in agricultural areas are the concern of a wide variety of organizations and institutions including soil and water conservation districts and commissions. In urban areas, local public works and planning departments can often respond to questions about the effects of land disturbance on ground water.

Federal statutes that authorize ground water protection include the **Safe Drinking Water Act** (**SDWA**), the **Resource Conservation and Recovery Act** (**RCRA**), and the

Comprehensive Environmental Response, Compensation, and Liability Act (**CERCLA**, or **Superfund** law). On the federal level, EPA has primary responsibility for ground water.

As an individual, you can help protect your community's ground water. Use and dispose of household hazardous substances properly. Reduce your use of these hazardous substances whenever possible. When you do have **pesticides**, cleaning products, and paint to dispose of, don't pour these products down the drain, put them in the trash, or dump them on the ground. Hazardous substances disposed of in these ways can find their way into both surface and ground water. Reducing home water use also will reduce ground water contamination.

Household products that are hazardous materials may be recycled. Check with local gas stations and automotive centers about recycling used motor oils and batteries and with paint stores for leftover paints and solvents. In many communities, businesses and government agencies sponsor annual Household Hazardous Waste Days when citizens can bring household chemicals to a central spot for collection, proper treatment, and/or disposal.

some questions & answers on ground water

Q. *How is ground water contaminated?*

A. Ground water may become contaminated when rainfall and surface runoff pass through contaminated soil. Water dissolves many substances and can carry particles and microorganisms with it into the ground water. **Landfills**, mining, improperly applied pesticides, improperly stored chemicals and de-icing salts, leaking **underground storage tanks**, improperly installed or failing **septic tanks**, and other surface activities can significantly alter ground water quality. Contamination often goes undetected for many years.

Q. *If I notice a change in the taste, color, or odor of my well water, whom should I contact?*

A. You should contact your county health department, state agency with ground water responsibility, and state health department. These agencies can investigate the cause of the change in your well water. In addition, information on ground water may be obtained by calling EPA's Safe Drinking Water Hotline (**800/426-4791**) or the U.S. Geological Survey (USGS) (**703/648-4460**).

Q. *What should I do if I suspect that a nearby facility may be contaminating my well and the ground water?*

A. You should contact the agencies listed above. Depending on the circumstances, they may be able to help you. You might also contact the state agencies that issue environmental permits to the facility; permits can be reviewed by the public.

Q. *Can contaminated ground water be cleaned up?*

A. In some situations, yes. Contaminated reservoirs that are limited in size may be cleaned up by pumping water out of the **aquifer** for treatment by above-ground treatment systems. Also, methods are under development to treat ground water in the subsurface, such as **biodegradation**. However, ground water cleanup is very difficult, expensive, and less than completely effective. Preventing ground water contamination is more practical to ensure good water quality.

Q. *Are permits required for water supplies and sewage treatment systems?*

A. Yes. State health and environmental agencies are responsible for certifying the adequacy of municipal water supplies and sewage treatment systems.

Q. *What is the relationship between ground water and surface water?*

A. **Surface water** seeps into **ground water** during wet weather periods and the reverse occurs during drought conditions. When close to the surface, ground water often becomes surface water in the form of springs, wetlands, and streams. Contamination of ground water can pollute surface water and vice versa.

Q. *Are* ***underground storage tanks*** *(**USTs**) regulated?*

A. Yes. In 1988, EPA issued regulations setting minimum standards for new tanks and requiring owners of existing tanks to close, replace, or upgrade them. Tank owners and operators are required to meet leak detection requirements and to show they have financial resources to pay for cleanups should a leak or spill occur.

EPA estimates that there are from 5 to 7 million USTs nationwide. Most of the USTs hold petroleum and the rest hold hazardous materials, used motor oil, or other substances.

Q. *Who runs the UST program and who should be notified if a leak is suspected?*

A. State and local governments oversee the UST program. Report suspected leaks to the state implementing agency. Contact the RCRA/Superfund/UST Hotline at **800/424-9346** for the name, address, and telephone number of the agency in your state.

pesticides

Few chemicals have had as much effect or been the subject of as much controversy in recent decades as pesticides. Broadly defined, a **pesticide** is any agent used to kill or control undesired insects, weeds, rodents, fungi, bacteria, or other **organisms**. Pesticides are used on food and feed crops, lawns and golf courses, in schools, in the home and other buildings, and to disinfect swimming pools and hospital equipment. Because of their wide application, EPA "registers" (licenses) thousands of pesticide products in the U.S. No pesticide may legally be sold or used unless the chemical's label bears an EPA registration number.

EPA must ensure that these pesticides will not present unreasonable risks to people, wildlife, fish, and plants, including **endangered species**. Under the **Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)** and its 1988 Amendments, the chemical's benefits must outweigh the risks. FIFRA gives EPA the authority to limit the amount of pesticide applied, restrict the frequency or location of application, or require the use of specially trained, certified applicators. EPA also can suspend or cancel the registration if later information shows that use of the pesticide poses unacceptable health effects.

Pesticide registration decisions are based primarily on EPA's evaluation of test data provided by applicants. Testing is needed to determine whether a pesticide can cause adverse effects, including acute toxic reactions, skin and eye irritations, cancers, birth defects, and reproductive system disorders. Data on how a pesticide behaves in the environment also is required. This information lets EPA determine whether a chemical poses a threat to ground water or to "non-target" species (other than those the pesticide is meant to control).

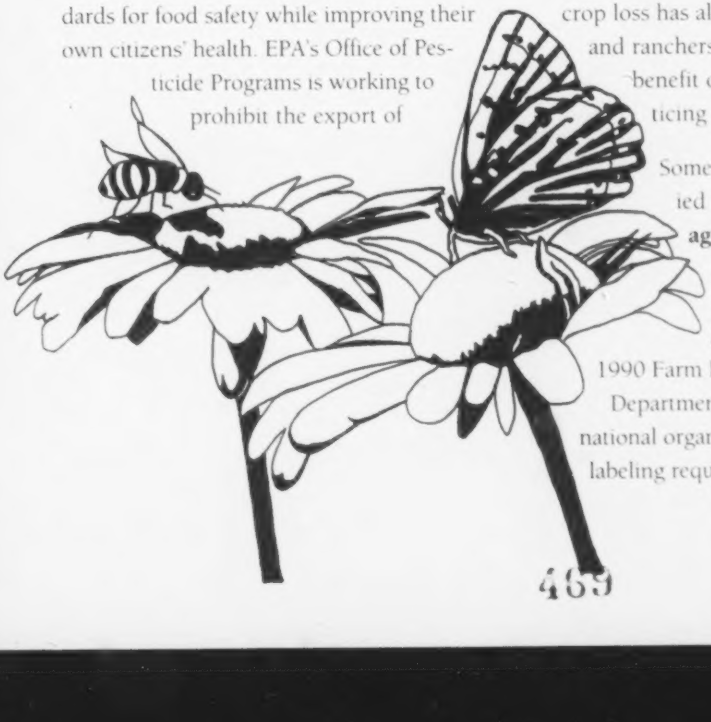
Many of us are concerned about food safety but don't understand how crops are raised or how our fruits and vegetables arrive at grocery stores. We seem to have an abundance of fresh produce every day, regardless of what is "in season." Advances in technology over the years have ensured bumper crops of many fruits and vegetables, and what we don't grow in this country we import from abroad.

Pesticides can be registered or re-registered under FIFRA for use on our food or feed crops only if "tolerances," or maximum legal limits, for residues are established under the Federal Food, Drug, and Cosmetic Act (FFDCA). These tolerances help ensure that consumers (especially infants and children) are not exposed to unsafe levels of pesticides remaining in or on their food. EPA sets a tolerance only if chemical and toxicological data, as well as residue and food consumption data, show no unreasonable risk to consumers from eating foods containing low-level residues of the pesticide—even over an entire lifetime.

EPA also is working to develop and maintain programs that will protect world health and the global environment from adverse effects of pesticide use. A major objective is to improve foreign countries' abilities to meet our standards for food safety while improving their own citizens' health. EPA's Office of Pesticide Programs is working to prohibit the export of pesticides that are banned from use in the U.S. because we may be importing fruits and vegetables grown and harvested with these same chemicals. Likewise, use of banned pesticides or improper application may lead to contaminated topsoil and ground water, and may have lasting adverse effects on wildlife in these other countries.

In addition, EPA is making a concerted effort to safeguard farmworkers in the U.S. through a combination of educational, regulatory, and research programs. Many farmworkers are non-English-speaking immigrants who are unable to read instructions or warnings on product labels. These applicators must contend with many insect and weed species that have become resistant to insecticides and herbicides, necessitating higher doses and increased applications. In the last 40 years, pesticide use has increased 10-fold, yet crop loss has almost doubled. Many farmers and ranchers have come to question the benefit of pesticides and started practicing alternative farming methods.

Some of these methods are embodied in the concept of **sustainable agriculture**, which was officially recognized by Congress when the Organic Foods Production Act was passed as part of the 1990 Farm Bill. This law required the U.S. Department of Agriculture to develop national organic certification standards and labeling requirements for crops that are



organically grown. USDA is being advised by a National Organic Standards Board composed of farmers, processors, scientists, and environmentalists. USDA will be publishing regulations that list synthetic and natural substances and **biochemicals** that will be permitted or prohibited in organic production. Any formulated products must be registered with EPA.

As a consumer, you can remove pesticide residues by thoroughly washing your fruits and vegetables with soap and water. If you feel you need to use a pesticide in your home, first seek advice from local professionals. Many nurseries, hardware stores, and garden centers have staff who are knowledgeable about the best product to use and how to apply the chemical. You may not need a pesticide at all—sometimes cleaning or removal of objects attracting a "pest" are all that is necessary. Take special precautions to apply the chemical exactly according to the label instructions. Wear protective clothing indicated on the label over hands and face and keep all containers isolated from children or pets. Close off rooms to children and pets when a pesticide has been applied, and never use a pesticide close to your face.

Outdoors, be aware that pesticides also can kill many beneficial insects as well as birds and squirrels. Some chemicals are unusually persistent, meaning residues are left in the environment for long periods of time, even years. Watch for "Household Hazardous Waste Disposal Days" in your community to bring any unused amounts or empty containers for proper disposal. Because of their inherent nature, all pesticides, including home, lawn, and garden pesticides, are potentially toxic and should be used with the utmost care.

some questions & answers on pesticides

Q. *Are there any alternatives to using pesticides?*

A. Yes. Scientists have begun to manage, rather than try to eradicate, certain species using **Integrated Pest Management** (IPM). IPM uses a combination of biological, cultural, and genetic control methods, with use of pesticides as the last resort. Understanding a species' life cycle is essential to reduce the use of pesticides. Population explosions can be prevented and reptiles, birds, bats, and predator insects used as natural pest controls. A sustainable farm **ecosystem** provides habitat for a multitude of beneficial organisms which maintain the pest-predator balance.

Q. *What natural controls can I use in my garden?*

A. Many garden shops and nurseries have resident experts on this topic, as do county extension services. Some common methods include planting marigolds to repel asparagus beetles. Beer or vinegar in a shallow pan readily attracts and traps slugs and snails. Gypsy moths on oak and ornamental trees can be controlled by a common bacterial spray applied at the hatching and early larval stages (a form of IPM). In addition, several soaps are on the market that are pest-specific and biodegradable.

Q. *How can I get rid of cockroaches in my kitchen?*

A. Mix equal parts of powdered sugar and powdered boric acid, obtainable from any hardware store. Sprinkle in corners and along baseboards. Find points of entry and seal them off. Store food in sealed containers and keep the kitchen clean. At night, drain your sink and wipe dry. Cockroaches are dependent on water, so check for small leaks under the sink and seal.

Q. *What does* ***organically grown*** *mean?*

A. Growing organically is an alternative approach that views the farm as an agro-ecosystem. The key principle is **biodiversity**, first accomplished by building a balanced, fertile soil rich in microorganisms. This concept of "feeding the soil, not the plant" imparts resistance and vigor to the crops grown. A diversity of crops are grown in a long period of rotation, particularly grasses and legumes for animal forage and green manures. Such rotations break pest life cycles, improve soil fertility, and reduce soil erosion. In addition, the natural resources on the farm such as forests, **wetlands**, and meadows are viewed as critical resources for climate and water management and provide habitat for indigenous species.

Certified organic crops can be harvested after three continuous years since the last application of a prohibited pesticide or fertilizer. But organically grown does not mean "no spray." Farmers can use naturally derived pesticides that break down quickly in the environment; some wash off with rain. Other synthetically derived materials that can be used include toxins from bacteria, soaps, fish emulsions, vitamins, minerals, and certain medicines for livestock. In practice, livestock must be fed organically grown grains and forages, and can receive no hormones, antibiotics, or medications that increase growth or production.

Q. *What pesticides are banned in the U.S.?*

A. Over the years, EPA has banned 42 different pesticides, including aldrin, DDT, dinoseb, and vinyl chloride. Others are called restricted-use, meaning they must be applied by or under the direct supervision of a certified applicator. Banned or restricted chemicals are acutely toxic to farmworkers and applicators, as well as various mammals, birds, and aquatic animals, and have environmental effects long after suspended use.

hazardous waste

Today's world is complex — sophisticated technologies produce consumer goods ranging from cars to cleaning fluids. Many of these processes generate **hazardous wastes** of one sort or another. Hazardous wastes are specifically identified by EPA because they have characteristics that make them potentially dangerous. Hazardous wastes include chemicals that are **corrosive, flammable, reactive**, or toxic. Hazardous wastes may be **by-products** of manufacturing processes or discarded consumer products, such as household cleaning fluids, paints, and batteries.

Once generated, hazardous wastes require proper storage, treatment, and **disposal**. While major industries must follow specific regulatory requirements for handling hazardous wastes, many companies are instituting **pollution prevention** techniques that reduce the amounts of wastes that are generated. Individual citizens also should try to reduce the amounts of chemicals used. When we must discard hazardous materials such as **pesticides** and old paint, we should follow proper disposal practices to protect our environment.

Currently operating industries that produce hazardous wastes are regulated by the provisions of the **Resource Conservation and Recovery Act (RCRA)**. One of the RCRA requirements is the **cradle-to-grave** reporting system that tracks hazardous wastes from the factory through transportation, treatment, and **disposal**. Most states have received authority from EPA to regulate and enforce RCRA; EPA controls hazardous waste storage, treatment, and disposal in those states that do not have this authority.

In addition to active facilities regulated under RCRA, some sites have abandoned hazardous wastes for which ownership is unclear or unknown. In these situations, control and cleanup is possible through the **Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)**, commonly known as **Superfund**. Under the Superfund program, EPA has the authority to clean up the nation's worst hazardous waste sites using money from a trust fund supported primarily from a tax on chemical **feedstocks** used by manufacturers. Those sites have been placed on EPA's **National Priorities List (NPL)**. Companies or individuals responsible for the wastes are identified by

EPA, if possible, and made to pay for the cleanups.

Your participation as a concerned community member is an integral part of the Superfund cleanup process. The **Superfund Amendments and Reauthorization Act (SARA)** of 1986 specifically provided for public participation in selecting the appropriate remedies for site contamination problems. EPA assigns staff to each Superfund site to work with the local community to reach decisions related to site cleanup activities. EPA is required to make site-related information accessible to the public. In most cases, this information and records of EPA decisions about the site are placed in the public library or town hall.

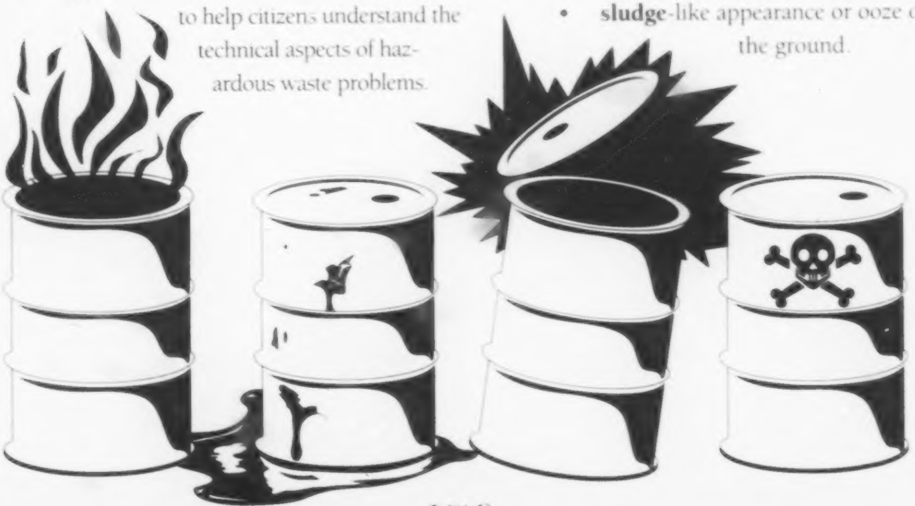
Communities near Superfund sites have numerous resources available to them for meaningful participation in the management and cleanup of the site. For example, technical assistance grants (TAGs) from EPA are authorized under SARA. These grants allow communities to hire experts to help citizens understand the technical aspects of hazardous waste problems.

some questions & answers on hazardous waste

Q. *What should I do if I suspect hazardous waste dumping?*

A. Contact the **National Response Center** at **1-800-424-8802** if you detect signs of illegal dumping such as:

- drums in the woods, on roadsides or abandoned property, in empty buildings or city or county **landfills**;
- odors that smell like turpentine, paint, fingernail polish, glue, rotten eggs, or any unfamiliar chemical odor;
- discolored soil with dead vegetation along roadsides, in abandoned lots or fields, around vacant buildings, or beside streams and rivers;
- abandoned warehouses or factories with leaking drums or waste-like material;
- **sludge**-like appearance or ooze on the ground.



Q. *Are hazardous substances regulated under RCRA?*

A. No. RCRA only regulates hazardous substances once they become wastes, but some hazardous substances are regulated under the **Toxic Substances Control Act (TSCA)** or by the **Occupational Safety and Health Administration (OSHA)**. Many hazardous chemicals must be reported to federal, state, and local officials under the **Emergency Planning and Community Right-to-Know Act (EPCRA)**.

Q. *Can hazardous wastes be incinerated safely? Does incineration make hazardous wastes non-hazardous?*

A. A hazardous waste **incinerator** that is properly designed and operated to meet performance standards set by EPA can safely and effectively reduce or destroy a wide variety of hazardous wastes. Depending on the composition of the hazardous wastes, some wastes can be rendered non-hazardous. The residues left after incineration, such as ash and materials from air pollution control equipment, must be properly managed and disposed of in accordance with EPA requirements.

Q. *Why are new commercial incinerators being built?*

A. Federal legislation mandated each state to provide, by October 17, 1989 a 20-year plan to assure that the state had the capacity to dispose of hazardous and solid wastes generated within its borders. Most hazardous wastes cannot be landfilled and some must be incinerated because they have no other disposal method. In addition, many states simply have no available landfill space, and so municipal solid waste, including household garbage, must be incinerated. But many new facilities are waste-to-energy plants which convert the heat from combustion into electricity for the community, an added bonus to eliminating tons of trash.

Q. *How are citizens assured that permitted hazardous waste facilities are complying with the law?*

A. Hazardous waste inspectors have the right to enter a facility at any reasonable time for an inspection, which may be unannounced. Facilities are inspected for compliance with laws and regulations, as well as with the specific conditions of their individual permits. When violations are found, they are followed by appropriate actions, ranging from issuance of a non-compliance notice to initiation of a criminal investigation. If you have reason to believe that a hazardous waste facility is not complying with the law, call your state environmental office with responsibility for hazardous waste. A complaint filed with the agency may result in an unannounced inspection of the facility.

Q. *What is the difference between hazardous waste management and treatment?*

A. Hazardous waste management refers to the precautions taken to reduce the dangers of handling or disposing of hazardous wastes.

Hazardous waste treatment refers to practices which render the wastes non-hazardous or less harmful. Treatment methods include **neutralization**, such as mixing **acids** with bases to make their **pH** more like that of water, biological treatment to break the waste down into simpler compounds, and incineration.

Q. *What is being done to reduce hazardous wastes?*

A. Better manufacturing processes and worker training are reducing quantities used and non-hazardous or less hazardous ingredients are being substituted in processes. Some wastes are refined and recycled; others are immobilized so they cannot be released into the environment. Another important way is to design well-managed, well-regulated hazardous waste management facilities with proper state permits.

Q. *Officials in my area have just declared an old abandoned property in my community a Superfund site. What does that mean?*

A. Under CERCLA, abandoned hazardous waste sites that pose an immediate threat can be cleaned up under emergency response and removal programs. Sites that do not pose an immediate danger but have significant contamination may be cleaned up by responsible parties or under federal or state investigation and cleanup programs.

Q. *Shouldn't the folks who put the chemicals in the dump pay for the cleanup?*

A. Yes. Using Superfund enforcement authority, EPA locates the owners, operators, generators, and transporters and negotiates for the cleanup. Those who contributed only minimal amounts or low-toxicity wastes (de minimis parties) can "cash out", putting their proportional share of costs into a trust fund for the cleanup. Or EPA can order non-cooperative parties to conduct the work. Cleanup doesn't have to wait until legal and financial issues are resolved. EPA can stabilize the site and then pursue responsible parties to recover costs and commit to long-term remedial actions.

Q. *How do I dispose of household hazardous wastes, such as old pesticides, paints, acids, cleaners, and used oils?*

A. Watch your newspaper for local "Household Hazardous Waste Disposal Days." Often local organizations or businesses, in cooperation with state environmental agencies, will sponsor free disposal if you bring your materials to a specified collection site. Public service announcements on television and radio also help to promote such events. In addition, some local gas stations recycle used motor oils and old automobile batteries.

The best way to deal with household hazardous wastes is to purchase products wisely. Estimate your needs accurately and buy the smallest quantity possible.

solid waste

Solid waste continues to receive a great deal of media attention across the country as cities and counties deal with the lack of available space to dispose of household garbage and municipal solid waste. How to manage our wastes has been a problem for decades. In the early 1960s, cities and towns across the country practiced open air burning of trash. In response, Congress passed the Solid Waste Disposal Act in 1965 as part of the amendments to the **Clean Air Act**. This was the first federal law that required environmentally sound methods for **disposal** of household, municipal, commercial, and industrial waste.

In 1970, Congress amended this law and passed the Resource Recovery Act, the first nationwide recycling initiative. Federal agencies were recycling high-grade white paper and newsprint with the slogan, "Use it Again Sam." The beverage industry at this time switched from tri-metal to the lighter but more expensive aluminum, primarily to save transportation and equipment costs. That switch paved the way for other major recycling efforts and created a demand for "post-consumer" materials.

But the early days of the "sanitary" **landfill** fouled **ground water**, soil, **surface water**, and air because of improper disposal methods. Engineers have since designed new liners and **leachate** treatment systems to prevent environmental degradation. Today, landfill space is at a premium. Other options include **incineration, recycling, source reduction**, and **biodegradation** as viable alternatives to solid waste disposal.

Each of us is part of the problem as well as the solution. From gum wrappers to used cars, we exert our personal choices in what we purchase, how we use the product, and how we dispose of the waste.

Simple solutions include purchasing goods with less packaging, maintaining and repairing household appliances, and carrying reusable shopping bags. **Recycling** newspapers, aluminum cans, glass, and some plastics is becoming more common at schools and the workplace. Even if your town does not have a recycling program, you can effectively reduce waste while conserving raw materials and energy. Yard and food wastes make up at least 25% of materials heading for landfills. But making **compost** of these wastes replaces soil nutrients and commercial fertilizers when placed in the garden. Removal of these materials from household garbage also extends the useful life of existing landfills.

some questions & answers about solid waste & waste disposal

Q. *How do we dispose of solid wastes?*

A. In 1990, more than 67% of our wastes were landfilled. We recycled about 17% and the balance (16%) was incinerated.

Q. *How is out-of-state garbage regulated?*

A. Current legal readings of **interstate commerce** laws suggest that a state, in general, cannot flatly refuse to accept out-of-state waste. In other words, wastes exported to your state may be restricted only to the degree in-state wastes are restricted. For example, if in-state or county mandatory recycling laws are enacted to require separation of waste into recyclable and non-recyclable components, out-of-state waste can be restricted in a similar manner.

Q. *What goes into a solid waste landfill? What happens to it over time?*

A. In 1990, on average, the solid waste that went into a typical municipal landfill was estimated to contain 38% paper; 18% yard waste (trimmings, leaves, etc.); 8% metals; 7% food; 7% glass; 6% wood; 8% plastics; and 8% miscellaneous. Biodegradable materials may decompose over many years, while non-degradable materials, such as glass and most plastics, remain at the site.

Q. *When rainfall leaches through an unlined landfill, how is ground water affected?*

A. Leachate can contain a variety of substances depending upon the contents of the waste, including metals, organic compounds, suspended particles, and bacteria. If toxic wastes are deposited in the landfill, the leachate can contain toxic chemicals that are hazardous even at low levels. Many of these substances pollute the ground water.

Most leachates are collected at permitted landfills and treated at local sewage treatment plants. Treatment can include aeration to eliminate **volatile** compounds and gases and to enhance oxygen-dependent breakdown of organics, settling or filtering to remove sediment, and other treatment to stimulate chemical or microbial breakdown of contaminants.

Q. *Are hazardous wastes disposed of in landfills?*

A. Both hazardous and solid waste regulations prohibit disposal of hazardous waste in a landfill that is not specifically designed and permitted. Nevertheless, we generate a great deal of hazardous wastes in our homes that we unwittingly dispose of daily. For example, pesticides and paint thinners may be tossed in trash taken to the landfill. Most businesses are regulated and monitored for their hazardous waste disposal practices. Although some people and companies illegally put hazardous wastes in landfills, heavy penalties including fines and jail sentences make illegal disposal very unattractive.

Q. *How do we know that infectious hospital wastes are not going into landfills?*

A. Only non-infectious hospital waste can be legally dumped in a non-hazardous waste landfill. Hospitals operate under regulations that specify disposal requirements for **medical wastes**. Violations of these rules can subject hospitals to substantial penalties.

Q. *How is the volume of waste entering a landfill regulated?*

A. Generally, the volume of waste accepted is set in the terms of the landfill permit, usually as tons per month. The landfill operator weighs the waste upon arrival, and tonnage reports must be submitted on a periodic basis to state environmental agencies.

Q. *How close can a landfill be to my house?*

A. State and local regulations may require that a landfill be a minimum distance from an occupied dwelling unless written permission to be closer is given by the occupant. A common distance is 500 feet.

Q. *Won't a landfill attract pests such as rats, flies, and cockroaches?*

A. At the end of each day, a landfill is required to be covered with a layer of soil to deter scavenging animals. If the cover is properly applied, these pests should be less of a problem.

Q. *How will a landfill affect my well water? Who can check my water to be sure it remains unpolluted?*

A. Some state and local regulations require a landfill to be located a minimum distance (in some states, at least 1,200 feet) from a well water supply. **Monitoring wells** required around the landfill aid in the detection of ground water contamination before it reaches the drinking water well. Monitoring reports are usually available upon request from the county government, state environmental agency, or your local health department, or county extension service.

If a well owner desires testing of a well, a certified laboratory should be hired to run the tests. Names of such laboratories can be obtained from your local health department.

Q. *How is a landfill closed? Are there any possible uses or restrictions for a closed landfill?*

A. A landfill that reaches capacity is covered with a multi-layer, protective **cap** and planted with grasses and other ground covers. The owner must then conduct post-closure care, which includes monitoring of ground water, landfill gases, and leachate collection systems. Monitoring may be required for 30 years following closure.

Few restrictions exist on how the property over a closed landfill can be used. Parks and golf courses are examples of possible uses. Construction of large buildings is usually avoided because of settling that occurs during biodegradation and compaction of the waste.

public health

Society's earliest historical records reveal that public health problems have been associated with life in large communal groups. Early writers documented such epidemic diseases as cholera, plague, and polio, and attributed them to crowded living conditions in cities and villages. Epidemics were later traced by scientists and physicians to lack of sanitation and disease-carrying **organisms**. With these discoveries, public health agencies emerged to prevent such occurrences by building sewers and water purification plants. Innoculation campaigns continue through modern times.

Public health research today addresses the more difficult cause and effect relationships behind cancer, leukemia, and birth defects. Citizen participation in these investigative activities through questionnaires and providing illness and lifestyle information greatly assists in the effort. But minority and low-income communities are often characterized by poor health and lack of education, two factors that exacerbate exposure to **toxic substances**. EPA has committed to address **environmental justice** concerns by bringing people of all races, cultures, incomes, and educational levels into the mainstream of environmental laws, regulations, and policies.

A major public health issue today is exposure to lead. Elimination of leaded gasoline has reduced air-borne exposure for the general population. But threats remain for children, who are most susceptible to the adverse effects of lead. In many homes, lead from old pipes and solder may dissolve into the water. If you have plumbing that was installed before the early 1950s, you can reduce your exposure to lead by letting the tap run for a few minutes. Use only cold water for cooking or drinking.

Another avenue of exposure to small children, and perhaps the greatest, is through lead paint in older housing. Small children tend to stick almost anything in their mouths. If a child swallows chips of lead-based paint, exposure to lead is increased. To help protect small children, the Consumer Product Safety Commission no longer allows the sale of paints with high levels of lead. The Centers for Disease Control and Prevention suggests that paint already existing inside and outside of buildings be tested for lead. If the lead content is high, the paint should be removed in a safe manner and replaced with a lead-free paint.

State health departments often oversee public water supplies and private **septic tanks** in addition to duties associated with food safety. Many states maintain registries of diseases such as cancer and birth defects. Studying patterns of incidence may help identify causes and allow public health agencies to target resources on high risk diseases, behaviors, or locations. The **Centers for Disease Control and Prevention (CDC)**, an arm of the U.S. Department of Health and Human Services (HHS), conducts research on the causes of disease and tracks the progression of infectious and other diseases. **The Agency for Toxic Substances and Disease Registry (ATSDR)** is a part of the Public Health Service in HHS. The mission of ATSDR is to protect the public from exposure to hazardous substances in the environment. See Government Agencies section.

some questions & answers on public health

Q. *Where can I find information about disease rates in my community?*

A. In many states, the state health department may have a registry of diseases such as cancer. A call to your state health department should let you know if the registry can give you information specific to your community. Your local health agency may also be aware of research that may have been performed in your community by universities or other researchers.

Q. *Do chemical companies and other industries keep track of employees' cancer and respiratory illnesses and deaths?*

A. Many large companies do. Some companies keep extremely detailed medical records on employees. Larger companies may have an **epidemiologist** who studies the incidence of disease in workers. Smaller companies may not have as detailed medical records on employees and may not keep them for long.

Q. *Whom do I call about suspected contamination of my public water supply?*

A. The water pollution control agency or public works department in your county or state has an office dealing with the safety of public water supplies. Ask them for the office to contact with questions and concerns.

The NRC is the primary communications center for reporting major chemical and oil spills and other hazardous substances into the environment. Operated by the U.S. Coast Guard since 1972, the NRC receives reports of transportation emergencies, oil and hazardous substance spills, and other chemical accidents.

community safety

Every day, oil and hazardous substances are spilled or released into our harbors and waterways; onto the ground, and into the air. Some of these incidents are relatively minor, some cause disruptions in the community, and others cause serious damage and take lives. Most such incidents are handled at the local level, by fire fighters, police, and emergency medical teams. In many cases, the owner or operator of a facility will handle the cleanup or provide help to local responders, sometimes in the form of technical advice or a trained hazardous materials team.

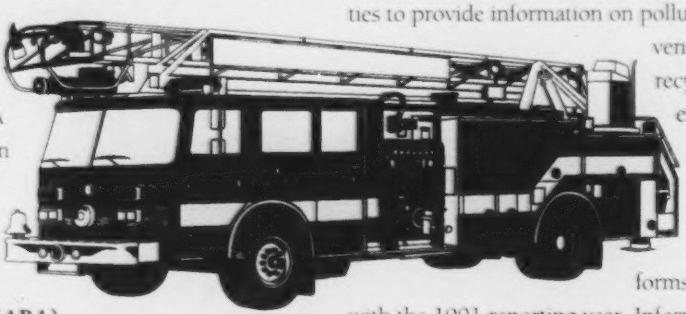
Some serious incidents, however, warrant activation of the National Response System. When the person in charge of a facility or vessel containing a hazardous substance becomes aware of a release in a reportable quantity, that person must notify the **National Response Center (NRC)** at **1-800-424-8802**. Reportable quantities have been established for 779 hazardous substances. Similarly, a discharge or spill of oil that causes a discoloration or "sheen" on the surface of the water must be reported.

The NRC relays information to a predesignated federal **On-Scene Coordinator (OSC)**, based on the incident's geographical location. Coastal and tidal waters fall under Coast Guard jurisdiction; EPA manages inland waterways and spills on land; the Departments of Defense and Energy manage incidents on their respective properties.

When the federal OSC receives a call, he is backed up by Special Forces: the U.S. Coast Guard's **National Strike Force (NSF)** composed of three teams: Atlantic, Pacific, and Gulf coasts; EPA's **Environmental Response Team**; and the **NOAA Scientfic Support Coordinators**. EPA's 10 regional offices each have a team of OSCs and direct responders who can access any of the Special Forces for assistance. The OSC in turn contacts state and local agencies to coordinate their role.

State Emergency Response Commissions (SERCs) administer community safety programs and appoint **Local Emergency Planning Committees (LEPCs)** in all major cities and every county. LEPC members include state or local officials, police, fire, public health, environmental, hospital, and transportation officials, as well as community groups and the media. The **Emergency Preparedness Coordinator** at the county level is usually the chairperson of the LEPC and has a listed telephone number, although large cities frequently have a separate LEPC.

The key statute directing all of these federal and state activities is the **Comprehensive Environmental Response, Compensation, and Liability Act of 1980** (**CERCLA**). When CERCLA was amended in 1986 by the **Superfund Amendments and Reauthorization Act (SARA)**, Title III of SARA authorized the **Emergency Planning and Community Right-to-Know Act (EPCRA)**. This law is based on the premise that citizens have a right to know about chemicals in their communities. EPCRA has two main purposes: to encourage planning for responses to accidents, and to provide the public and the government with information about possible chemical hazards in communities.



Section 313 of EPCRA requires certain manufacturers (those in **Standard Industrial Classification (SIC) Codes** 20-39) to report to EPA and the states the amounts of over 300 **toxic chemicals** and 20 chemical categories that they release directly to air, water, or land, inject underground, or transfer to off-site facilities. In addition, EPCRA specifies that EPA must compile these reports into an annual inventory of releases and transfers — the **Toxic Release Inventory (TRI)** — and make that inventory available to the public.

In October of 1990, Congress passed the **Pollution Prevention Act**, requiring all TRI facilities to provide information on pollution prevention and recycling efforts for each chemical on their reporting forms beginning with the 1991 reporting year. Information includes quantities recycled, source reduction practices, and changes in production. EPA recently added two chemical categories and 32 additional chemicals that require reporting.

By the end of 1994, EPA will add 313 priority pollutants to the list, including acutely toxic chemicals, flammable gases and liquids, explosives, and **pesticides**. Small-source exemptions will be proposed at that time. In early 1995, TRI reporting will be extended to treatment plants for drinking water, utilities, mining companies, propane retailers, and other nonmanufacturing industries associated with significant chemical releases.

These right-to-know efforts have been enhanced by a 1994 Executive Order committing EPA and other federal agencies to **environmental justice** for minority and low-income populations. Efforts to educate and empower citizen groups, native Americans, and new immigrants to our shores will ensure early participation in environmental decision making, form partnerships, and promote sustainable communities.

Another law intended to improve public safety is the **Hazardous Materials Transportation Uniform Safety Act (HMTUSA)**. Under this law, local emergency planners and responders can receive grants and technical assistance from the federal government to help communities deal with the risks from transporting hazardous materials. HMTUSA is aimed at improving transportation safety by ensuring that hazardous material manufacturers, transportation companies, and community safety officials reduce the threat of chemical accidents on our nation's highways, railroads, and waterways.

some questions & answers on community safety

Q. *How do I know what chemicals are used or made in an industrial plant near my home and what amounts are being stored there?*

A. Ask the plant for a copy of EPCRA Section 311 and 312 data submitted to the LEPC and an explanation of the codes used. Or, ask the LEPC for this information.

Q. *In case of an accident at a chemical plant, who will warn me and my family about toxic emissions and provide for appropriate protection?*

A. Your LEPC has developed warning systems, evacuation plans, and shelter-in-place instructions. You can also ask the local plant to explain how their emergency response plans mesh with the LEPC. The plant must report immediately all incidents of chemical releases to the NRC, the SERC, and the LEPC.

Q. *Are visible, continuous* ***emissions*** *or odors from an industrial plant harmful?*

A. To identify whether specific emissions are harmful, you should ask the plant manager about emissions and request a copy of the plant's SARA Section 313 data. Or, ask your SERC for the data. EPA's Chemical Emergency Preparedness and Prevention Office also may be able to help. After identifying the chemicals and volumes being emitted, **Material Safety Data Sheets (MSDS)** may help you to determine **risk**. Remember that risk depends on the dose received; Section 313 data are reported annually and can not be used alone to accurately determine exposure or dose, or their consequences.

Q. *Where do I get the MSDS for the emissions in question? Can I understand an MSDS? Isn't it too technical?*

A. An MSDS is a fact sheet that describes how to use, handle, and dispose of a specific chemical (see the Glossary). The plant that manufactures, stores, or **discharges** the chemical must submit an MSDS to the LEPC. Ask the LEPC or the plant safety manager for help in interpreting the information.

Q. *What is the difference between hazardous chemicals and toxic chemicals?*

A. Hazardous chemicals are a much broader category and may be toxic, **flammable**, **corrosive**, explosive, or environmentally harmful. Substances which are toxic can cause severe illness, poisoning, or death when ingested, inhaled, or absorbed by living organisms. Toxic chemicals are one type of hazardous chemical.

Q. *If I am exposed to a small amount of a* **toxic chemical** *once, are my chances of getting cancer the same as someone who is exposed to the chemical everyday?*

A. Generally, no. **Exposure** relates both to the amount and frequency of coming into contact with a specific chemical. Federal agencies have established certain exposure limits for workers that prevent them from becoming ill. Repeated exposure to low levels of a mix of chemicals may be linked to health problems, while a single incident at a higher level may be below a toxic threshold.

Q. *What processes can be used to reduce or eliminate the hazards presented by the storage and transportation of large volumes of hazardous chemicals?*

A. There are some technologies, called continuing or closed-loop processes, that convert hazardous or dangerous compounds into more stable or less **toxic substances** in a single continuous system. That is, some chemicals are immediately converted or recombined in the manufacturing process to reduce **risks** that would otherwise be posed by transportation and storage. Some companies also are using just-in-time delivery to reduce the need to store large volumes of chemicals.

Q. *Where can I go to get more information about chemical risks?*

A. Ask EPA's Office of Research and Development, your LEPC, environmental or consumer activists, or any of several other organizations in the directory at the end of this Guide.

health & environmental risk

Risk is a description of the chance that some hazard to health or the environment will occur. For example, insurance companies commonly use risk to assess the probability that a driver will or will not have an accident. While society has always assessed risk, it was not until recently that risk has been discussed as a policy-making tool for health and environmental issues.

Risk assessment is an evaluation of the potential for a problem to occur and the scientific analysis of its threat to public health and the environment. The evaluation may include toxicology, epidemiology, and exposure data and provides a systematic analysis of risks. While risk assessments are based on science, they are rarely precise, since absolute data almost never exist.

In attempting to control risks, environmental managers examine the options and select those that best reduce risk. Some management decisions may lead to elimination of the risk altogether. Since precise estimates of risk often are not possible, policy makers may use qualitative risk assessments to identify substances or activities that pose a risk to our health and the environment. With good data, quantitative risk assessments can go a step further to identify how much of a substance or activity may cause a harmful effect. For example, exposure to 10 grams of a chemical compound may create a specific health problem, or the loss of 20% of the trees in the Amazon basin may cause a number of severe problems for wildlife.

Risk analysis is used by agencies, industries, and individuals every day to identify health and environmental problems in our society. Regulatory agencies use risk assessment as a tool to evaluate health and safety issues such as food safety and workplace exposure. Chemicals or practices that are identified as very risky receive more management attention then those perceived to be less risky.

Risk communication is the exchange of information between interested parties and is a tool for understanding many environmental risks. To enhance public outreach activities about risk, EPA is working toward **environmental equity** so that no segment of the population, regardless of race, national origin, or income bears a disproportionate share of **exposure** to environmental pollutants. For information on how agencies use risk assessments regarding specific public hazards, you should call EPA's Office of Policy, Planning, and Evaluation or your state agencies that deal with health and environmental protection.

some questions & answers on health & environmental risk

Q. *Can a risk assessment tell me exactly what to do about a specific hazard?*

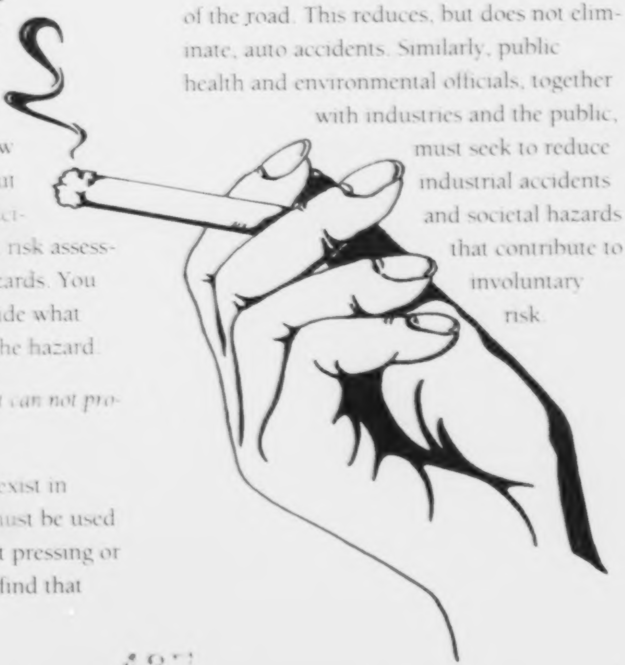
A. No. Risk assessments are often imprecise in that they draw upon available information about the hazard, apply scientific principles, and provide guidance. But risk assessments can help you identify hazards. You can use that information to decide what steps, if any, to take to reduce the hazard.

Q. *Why use risk assessment if it can not provide absolute answers?*

A. Because so many hazards exist in everyday life, risk assessment must be used as a tool for evaluating the most pressing or most hazardous. Over time we find that some activities are more hazardous than once perceived (smoking cigarettes or manufacturing PCBs). Once the evidence is evaluated, these practices may be either stopped or limited. An assessment on an unknown chemical or practice attempts to project what the consequences might be without waiting for final proof.

Q. *Is zero risk possible? Can we eliminate all risk?*

A. No. We live in a world with many risks, both natural and manmade, and many we take voluntarily. We can develop practices that reduce, but not totally eliminate, daily risks. For example, U.S. motor vehicle laws mandate that we drive on the right side of the road. This reduces, but does not eliminate, auto accidents. Similarly, public health and environmental officials, together with industries and the public, must seek to reduce industrial accidents and societal hazards that contribute to involuntary risk.



enforcement

Environmental enforcement is a comprehensive program involving federal, state, local, and tribal governments working together to enforce federal environmental laws. These laws set standards for what individuals and institutions must do to control or prevent **pollution**. Without enforcement, environmental laws would be just words on paper.

The term "enforcement" covers all efforts to encourage compliance with environmental laws. "Compliance" refers to the condition that exists when a person or company fully obeys the law. An environmental law without compliance would mean that pollution problems would continue and grow worse. EPA has an enforcement program to make sure that laws get the results that Congress and the public want. This program will include **environmental justice** concerns in all compliance efforts.

The fundamental aim of enforcement is to convince those who are regulated that it is better to comply quickly than to wait until they are caught. We use enforcement actions to compel a person or company to comply. These actions include civil and criminal prosecution in courts, administrative orders, and other forms of action that take place after a violation has occurred. Although directed at a specific violator, enforcement causes a deterrent effect that motivates other people to comply.

some questions & answers on health & environmental risk

Q. *Is EPA responsible for every environmental action?*

A. No. Virtually every federal environmental law allows state governments to develop their own programs to carry out the law. When EPA has determined that the state program meets federal requirements, EPA approves the program. Such programs are called "delegated" or "approved" programs. Under this arrangement, the states apply the national standards and regulations by issuing and enforcing their own rules and **permits**. State governments carry out the lion's share of environmental enforcement actions and perform a majority of the inspections.

Q. *What is the enforcement relationship between EPA and the states?*

A. EPA strives to work out an effective enforcement partnership with each state. This is accomplished through enforcement agreements with the separate state agencies. These agreements usually define the characteristics of a good program, using the same criteria by which EPA judges its own performance. The agreements also spell out the circumstances under which EPA will step in and take enforcement action in an approved state program (called "overfiling"). The most common reasons are: the state asked for help; the state's enforcement response was not timely and appropriate (according to EPA guidance); the case involves national precedents; or there is a violation of an EPA order or settlement agreement.

Q. *What is the range of enforcement responses?*

A. EPA's policy is to respond to every violation in some way, and the type of response will be in keeping with the seriousness and circumstances of the violation. EPA has a range of options when contemplating an enforcement response against a violator, and these options differ from one law to another.

- *Informal response*—administrative actions that are advisory in nature, such as a notice of noncompliance or a warning letter. In these actions, EPA advises the manager of a facility what violation was found, what corrective action should be taken, and by what date. Informal responses carry no penalty or power to compel actions, but if they are ignored, they can lead to more severe actions.
- *Formal administrative responses*—legal orders that are independently enforceable, and which may require the recipient to take some corrective or remedial action within a specified period of time, to refrain from certain behavior or to require future compliance. These administrative actions are strong enforcement tools. If a person violates an order, EPA may go to U.S. federal court to force compliance. Administrative actions are handled under EPA's internal administrative litigation system, which is comparable to any court system except that administrative law judges preside.
- *Civil judicial responses*—formal lawsuits brought in U.S. federal court by the **Department of Justice (DOJ)** at EPA's request. They are normally used against the more serious or recalcitrant violators of environmental laws or to seek prompt correction of imminent hazards. Civil judicial cases generally result in penalties and court orders requiring correction of the violation and specific actions to prevent future violations.

- *Criminal judicial responses*—used when a person or company has knowingly and willfully violated the law. In a criminal case, the DOJ prosecutes an alleged violator in federal court, seeking criminal sanctions including fines and imprisonment. Criminal actions are often used to respond to flagrant, intentional disregard for environmental laws (such as "midnight dumping" of **hazardous wastes**) and deliberate falsification of documents or records.

Q. *What happens as a result of an enforcement case?*

A. Most importantly, the enforcement action results in a remedy to the violations, but also serves as a deterrent to others. In many cases, EPA seeks both a remedy and a penalty. These may result from either administrative or judicial cases, and either from a settlement or from a final decision in court or an administrative action. The remedy includes returning the violating facility to compliance and sometimes other remedial actions:

- *Compliance*—the violator will be required to comply with the law. If the violation has not already been corrected, the violator is usually placed under a court-ordered schedule, with severe penalties for failure to comply with the order.
- *Benefit projects*—in some cases, the violator is permitted to carry out a supplemental environmental project that will yield environmental benefits partly offsetting the harmful effects of the violation.
- *Penalties*—the violator is required to pay a cash penalty that is not tax deductible (in criminal cases, a fine). The penalty includes sanctions intended to deter the violator from falling into noncompliance again and to deter others from similar violations.
- *Imprisonment*—in criminal cases, the violator may be sentenced to jail time or placed on probation.
- *Contractor listing*—a facility that has violated the **Clean Water Act** or the **Clean Air Act** may be placed on EPA's List of Violating Facilities. Listed facilities are not eligible to receive federal contracts, grants, or loans from EPA or any other federal agency. Facilities that commit criminal violations of other environmental statutes may be subject to possible suspension and/or debarment from receiving or entering into EPA or other federal agency contracts.

Q. *What is an inspection?*

A. Inspections are the government's main tool for officially assessing compliance. An inspection is an examination into the environmental affairs of a single regulated facility, to determine its compliance with environmental requirements. Inspection findings become the basis for a variety of possible actions EPA might take to bring the facility into compliance.

Q. *How does the EPA decide which facilities to inspect?*

A. While we would like to inspect every regulated facility on a regular basis, we do not have the funds or personnel to do so. As a result, each EPA program has a strategy or policy for allocating inspections to various segments of the regulated community and ultimately to particular facilities. Most inspections are routine, conducted because the facility is within a segment of the regulated community that has been targeted for inspection. Other inspections are "for cause," meaning there is some reason to suspect that an actual violation exists. The stimulus may be a tip, a citizen's complaint, a self-monitoring report, or information from the **Toxic Release Inventory (TRI)**. Inspections may be announced or unannounced.

Q. *Can a citizen file a suit to enforce an environmental standard?*

A. Yes. The first citizen suit provision appeared in 1970, when Congress enacted the Clean Air Act. Specifically, this provision allowed citizens to sue polluters who violated certain requirements of the Clean Air Act and to sue the EPA if we failed to carry out a non-discretionary duty set forth in the Act. Since 1970, a citizen suit provision has been included in almost every federal environmental statute. Under these statutes, Congress has granted citizens the power to initiate an enforcement action in federal court in order to ensure adequate protection of the environment. Citizen suits have proven to be an important tool for the enforcement of the various environmental statutes.

Q. *How can I recognize a potential pollution problem?*

A. While some pollution is an unfortunate consequence of modern industrial life, national and state laws limit the amount and kinds of pollution allowed. Sometimes a citizen can easily identify pollution that violates a law and sometimes we need sophisticated equipment. EPA encourages the public to "keep their eyes and ears open" and to contact the appropriate local, state, and federal authorities whenever they notice a potential pollution problem.

Q. *Whom should I contact to report a pollution incident?*

A. State and local governments have responsibility for enforcing most environmental laws in the area where you live. You can locate them through your telephone directory. In most communities, the responsible agency is the city or county health department. At the state level, an environmental agency carries out the pollution control laws, whereas an agriculture agency often handles regulation of **pesticides**. If they are unable to help you, contact the EPA, which principally operates through 10 Regional Offices. The Public Affairs office is a good starting point.

glossary

Acid - A corrosive solution with a **pH** less than 7. Vinegar is a common weak acid; battery acid is much stronger.

Acid Rain - You first need to understand Acid Deposition: a complex chemical and atmospheric phenomenon that occurs when emissions of sulfur and nitrogen compounds and other substances are transformed by chemical processes in the atmosphere, often far from the original sources, and then deposited on earth in either wet or dry form. The wet forms (precipitation) are popularly called "acid rain" and fall as rain, snow, or fog. The dry forms are acidic gases or particulates.

Active Ingredient - In any pesticide product, the component that kills, or otherwise controls, target pests. Pesticides are regulated primarily on the basis of active ingredients.

Activated Sludge Process - A sewage treatment process by which bacteria that feed on organic wastes are continuously circulated and put in contact with organic waste in the presence of oxygen to increase the rate of decomposition.

Acute Effect - An adverse effect on any living **organism** in which severe symptoms develop rapidly and often subside after the exposure stops.

Acute Toxicity - Adverse effects that result from a single **dose** or single **exposure** of a chemical; any poisonous effect produced within a short period of time, usually less than 96 hours. This term normally is used to describe effects in experimental animals.

Administrative Order on Consent - A legal agreement signed by EPA and an individual, business, or other entity through which the violator agrees to pay for correction of violations, take the required corrective or cleanup actions, or refrain from an activity. The order describes the actions to be taken, may be subject to a comment period, applies to civil actions, and can be enforced in court.

Administrative Order - A legal document signed by EPA directing an individual, business, or other entity to take corrective action or refrain from an activity. The order describes the violations and actions to be taken, and can be enforced in court. Such orders may be issued, for example, as a result of an administrative complaint whereby the respondent is ordered to pay a penalty for violations of a statute.

Administrative Record - All documents which EPA considered or relied on in selecting the remedy at a Superfund site, culminating in the record of decision for remedial action, or an action memorandum for removal actions.

Aeration - The act of mixing a liquid with air (oxygen).

Aerobic - A biological process that occurs in the presence of oxygen.

Agricultural Waste - Poultry and livestock manure, and residual materials in liquid or solid form generated from the production and marketing of poultry, livestock, furbearing animals, and their products. Also includes grain, vegetable, and fruit harvest residue.

Air Quality Standards - The level of selected pollutants set by law that may not be exceeded in outside air. Used to determine the amount of pollutants that may be emitted by industry.

Alar - Trade name for daminozide, a **pesticide** that makes apples redder, firmer, and less likely to drop off trees before growers are ready to pick them. Alar also is used to a lesser extent on peanuts, tart cherries, concord grapes, and other fruits.

Alkalinity - Having the properties of a base with a **pH** of more than 7. A common alkaline is baking soda.

Ambient - Any unconfined portion of the atmosphere; open air; outside surrounding air.

Anaerobic - A biological process which occurs in the absence of oxygen.

Aquifer - A water-bearing layer of rock (including gravel and sand) that will yield water in usable quantity to a well or spring.

Asbestos - A mineral fiber that can pollute air or water and cause cancer or asbestosis when inhaled. EPA has banned or severely restricted the use of asbestos in manufacturing and construction.

Assimilative Capacity - The ability of a natural body of water to receive wastewaters or toxic materials without harmful effects and without damage to aquatic life.

Bactericide - A **pesticide** used to control or destroy bacteria, typically in the home, schools, or on hospital equipment.

Benthic Organism - Any of a diverse group of aquatic plants and animals that lives on the bottom of marine and fresh bodies of water. The presence or absence of certain benthic organisms can be used as an indicator of water quality.

Best Available Control Technology (BACT) The application of the most advanced methods, systems, and techniques for eliminating or minimizing **discharges** and **emissions** on a case-by-case basis as determined by **EPA.** BACT represents an emission limit based on the maximum degree of reduction of each pollutant as described in regulations under the **Clean Air Act (CAA)**. The determination of **BACT** takes into account energy, environmental, economic effects, and other costs.

Best Available Technology Economically Achievable (BATEA) - Originally described under Section 304(b)(2)(B) of the **Clean Water Act**, this level of control is generally described as the best technology currently in use and includes controls on toxic pollutants.

Best Management Practices (BMP) - Procedures or controls other than **effluent limitations** to prevent or reduce **pollution** of **surface water** (includes runoff control, spill prevention, and operating procedures).

Bioaccumulation/Biomagnification - A process where chemicals are retained in fatty body tissue and increase in concentration over time. Biomagnification is the increase of tissue accumulation in species higher in the natural food chain as contaminated food species are eaten.

Bioassay - A method of testing a material's effects on living **organisms**.

Biochemicals - Chemicals that are either naturally occurring or identical to naturally occurring substances. Examples include hormones, pheromones, and enzymes. Biochemicals function as pesticides through non-toxic, non-lethal modes of action, such as disrupting the mating pattern of insects, regulating growth, or acting as repellants. Biochemicals tend to be environmentally compatible and are thus important to **Integrated Pest Management** programs.

Biochemical Oxygen Demand (BOD) - A measure of the oxygen required to break down organic materials in water. Higher organic loads require larger amounts of oxygen and may reduce the amount of oxygen available for fish and aquatic life below acceptable levels.

Biodegradable - The ability of a substance to be broken down physically and/or chemically by microorganisms. For example, many chemicals, food scraps, cotton, wool, and paper are bio-degradable; plastics and polyester generally are not.

Biodiversity - The number and variety of different **organisms** in the ecological complexes in which they naturally occur. Organisms are organized at many levels, ranging from complete **ecosystems** to the biochemical structures that are the molecular basis of heredity. Thus, the term encompasses different ecosystems, species, and genes that must be present for a healthy environment. A large number of species must characterize the food chain, representing multiple predator-prey relationships.

Biological pesticides - Certain microorganisms, including bacteria, fungi, viruses, and protozoa that are effective in controlling target pests. These agents usually do not have toxic effects on animals and people and do not leave toxic or persistent chemical residues in the environment.

Bioremediation - The use of living **organisms** (e.g., bacteria) to clean up oil spills or remove other pollutants from soil, water, and wastewater.

Biota - All living **organisms** in a given area.

Boom - (1) A floating device used to contain oil on a body of water. (2) A piece of equipment used to apply **pesticides** from a tractor or truck.

Bubble (Bubble Policy) - Existing sources of air pollution with several facilities may control more than is required at one **emission** point where control costs are lower, in return for comparable relaxation at a second point where costs are higher or more difficult to achieve.

By-product - Materials, other than the intended product, generated as a result of an industrial process.

Cap - A fairly impermeable seal, usually composed of clay-type soil or a combination of clay soil and synthetic **liner**, which is placed over a **landfill** during **closure**. The cap serves to minimize **leachate** volume during **biodegradation** of the waste by keeping precipitation from percolating through the **landfill**. The cap also keeps odors down and animal scavengers from gathering.

Capacity Assurance Plan - A plan which assures that a state has the ability to treat and dispose of hazardous wastes generated within its borders over the next 20 years. Section 104 of **SARA** required the first plan to be submitted to EPA in October 1989. But even though capacity has been certified, the state is not required to treat or dispose of hazardous wastes at home; many are exporting to other states that have commercial facilities, permitted landfills, and **incinerators**. See Law section.

Carcinogenic or Carcinogen - Capable of causing cancer. A suspected carcinogen is a substance that may cause cancer in humans or animals but for which the evidence is not conclusive.

CERCLIS (Pronounced SERK-liss) - The federal Comprehensive Environmental Response, Compensation, and Liability Information System. This database includes all sites which have been nominated for investigation by the **Superfund** program and the actions that have been taken at these sites. If the site investigation reveals contamination, the site is ranked and may be included on the **National Priorities List** for **Superfund** cleanup. Inclusion in the CERCLIS database does not necessarily mean that a property is a **hazardous waste** site. An emergency action may have been conducted there or a simple investigation which concluded that no further action was required.

Chemical Abstract Service (CAS) - Since the 1890s, CAS has been assigning identification numbers to chemicals that companies register with them. Every year, CAS updates and writes new chemical abstracts on well over a million different chemicals, including their composition, structure, characteristics, and all the different names of that chemical. CAS On-Line is a computer network available to individual and business account holders to receive information about specific chemicals of concern. Each abstract is accompanied by the CAS number.

Chemical Oxygen Demand (COD) - A measure of the oxygen-consuming capacity of inorganic and organic matter present in water or wastewater; the amount of oxygen consumed from a chemical **oxidant** in a specific test.

Chlorination - Adding chlorine to water or wastewater, generally for the purpose of disinfection, but frequently for accomplishing other biological or chemical results. Chlorine also is used almost universally in manufacturing processes, particularly for the plastics industry.

Chlorofluorocarbons (CFCs) - A family of chemicals commonly used in air conditioners and refrigerators as coolants and also as solvents and aerosol propellants. CFCs drift into the upper atmosphere where their chlorine components destroy **ozone**. CFCs are thought to be a major cause of the ozone hole over Antarctica.

Chronic Effect - An adverse effect on any living organism in which symptoms develop slowly over a long period of time or recur frequently.

Clear Cut - Harvesting all the trees in one area at one time, a practice that destroys vital habitat and biodiversity and encourages rainfall or snowmelt runoff, erosion, sedimentation of streams and lakes, and flooding.

Cloning - In biotechnology, obtaining a group of genetically identical cells from a single cell; making identical copies of a gene.

Climate Change - this term is commonly used interchangeably with "global warming" and "the greenhouse effect," but is a more descriptive term. Climate change refers to the buildup of man-made gases in the atmosphere that trap the sun's heat, causing changes in weather patterns on a global scale. The effects include changes in rainfall patterns, sea level rise, potential droughts, habitat loss, and heat stress. The greenhouse gases of most concern are carbon dioxide, methane, and nitrous oxides. If these gases in our atmosphere double, the earth could warm up by 1.5 to 4.5 degrees by the year 2050, with changes in global precipitation having the greatest consequences.

Closure - The procedure an operator must go through when a **landfill** reaches the legal capacity for **solid waste**. No more waste can be accepted and a **cap** usually is placed over the site. The cap is then planted with grasses and other ground covers. Post-closure care includes monitoring ground water, landfill gases, and **leachate** collection systems, sometimes for as long as 30 years.

Code of Federal Regulations (CFR) - A periodic publication of the regulations established by U.S. law.

Commercial Waste - All solid waste from businesses. This category includes, but is not limited to, solid waste originating in stores, markets, office buildings, restaurants, shopping centers, and theaters.

Commercial Waste Management Facility - A treatment, storage, disposal, or transfer facility that accepts wastes from a variety of sources for profit. A commercial facility manages a broader spectrum of wastes than a private facility, which normally manages a limited volume or type of waste.

Community Relations - Two-way communications with the public to foster understanding of EPA programs and actions and to increase citizen input into EPA decisions. Specific community relations activities such as holding public meetings and comment periods and opening information repositories are required at **Superfund** sites.

Compost - Decomposed organic material that is produced when bacteria in soil break down **garbage** and **biodegradable** trash, making organic fertilizer. Making compost requires turning and mixing and exposing the materials to air. Gardeners and farmers use compost for soil enrichment.

Concentration - The relative amount of a substance mixed with another substance. An example is five **parts per million** of carbon monoxide in air or 1 **milligram/liter** of iron in water.

Conditionally Exempt Generators - Small quantity facilities that produce fewer than 220 pounds of hazardous waste per month. Exempt from most regulations, conditionally exempt generators are required to determine whether their waste is hazardous and to notify local waste management agencies. These generators may treat or dispose of the waste **on site** or ensure that the waste is sent to a permitted disposal or recycling facility.

Cone of Depression - A lowering in the **water table** that develops around a pumped well.

Construction and Demolition Waste - Waste building materials, dredging materials, tree stumps, and rubble resulting from construction, remodeling, repair, and demolition operations on houses, commercial buildings and other structures, and pavements. May contain lead, asbestos, or other hazardous materials.

Corrosive - A substance that eats or wears away materials gradually by chemical action.

Consent Decree - A legal document submitted by the **Department of Justice** on behalf of the EPA for approval by a federal judge to settle a case. A consent decree can be used to formalize an agreement reached between EPA and potentially responsible parties (PRPs) for cleanup at a **Superfund** site. Consent decrees also are signed by regulated facilities to cease or correct certains actions or processes that are polluting the environment and include payment of penalties. The **Clean Water Act, Clean Air Act, Toxic Substances Control Act**, and others all use consent decrees.

Conservation - Preserving and renewing natural resources to assure their highest economic or social benefit over the longest period of time. Clean rivers and lakes, wilderness areas, a diverse wildlife population, healthy soil, and clean air are natural resources worth conserving for future generations.

Continuous Discharge - A permitted release of pollutants into the environment that occurs without interruption, except for infrequent shutdowns for maintenance, process changes, etc.

Controlled Reaction - A chemical reaction at temperature and pressure conditions that are maintained within safe limits to produce a desired product.

County Emergency Operations Plan - A plan required by **Federal Emergency Management Agency** regulations that describes actions the county will take to respond to emergency situations such as natural disasters, major fires, transportation incidents, or chemical releases.

Covered Facility - A facility having one or more of the 366+ **extremely hazardous substances** in amounts higher than the quantity designated by **EPCRA**. These facilities must file reports with the **SERC** and **LEPC**.

Cradle-to-Grave or Manifest System - A procedure in which **hazardous wastes** are identified as they are produced and are followed through further treatment, transportation, and disposal by a series of permanent, linkable, descriptive documents.

Criteria - Descriptive factors taken into account by EPA in setting standards for pollutants. For example, water quality criteria describe the **concentration** of pollutants that most fish can be exposed to for an hour without showing **acute effects**.

Dechlorination - Removal of chlorine and chemical replacement with hydrogen or hydroxide ions to detoxify a substance.

Deep Well Injection - A process by which waste fluids are injected deep below the surface of the earth.

Delist - Use of the petition process (1) to have a chemical's toxic designation rescinded, (2) to remove a site from the **National Priority List**; or (3) to exclude a particular waste from regulation even though it is a listed hazardous waste.

Destruction and Removal Efficiency (DRE) - a percentage that represents the number of molecules of a compound removed or destroyed in an **incinerator**. A DRE of 99.99% means that 9,999 molecules are destroyed for every 10,000 that enter.

Discharge - The release of any waste into the environment from a **point source**. Usually refers to the release of a liquid waste into a body of water through an outlet such as a pipe, but also refers to air **emissions**.

Discharge Area - An area of land where there is a net annual transfer of water from the **ground water** to **surface water**, such as to streams, springs, lakes, and wetlands.

Dispersion Model - A mathematical prediction of how pollutants from a **discharge** or **emission** source will be distributed in the surrounding environment under given conditions of wind, temperature, humidity, and other environmental factors.

Disposal - The **discharge**, deposit, injection, dumping, spilling, leaking, or placing of any **solid waste** or **hazardous waste** into the environment (land, **surface water, ground water,** and air).

Disposal Facility - A **landfill, incinerator**, or other facility which receives waste for **disposal.** The facility may have one or many disposal methods available for use. Does not include wastewater treatment.

Dissolved Oxygen (DO) - Oxygen that is freely available in water to sustain the lives of fish and other aquatic **organisms**.

Dose - In terms of monitoring **exposure** levels, the amount of a **toxic substance** taken into the body over a given period of time.

Dose Response - How an **organism's** response to a **toxic substance** changes as its overall **exposure** to the substance changes. For example, a small dose of carbon monoxide may cause drowsiness; a large **dose** can be fatal.

Dump - A land site where wastes are discarded in a disorderly or haphazard fashion without regard to protecting the environment. Uncontrolled dumping is an indiscriminate and illegal form of waste **disposal**. Problems associated with dumps include multiplication of disease-carrying organisms and pests, fires, air and water pollution, unsightliness, loss of habitat, and personal injury.

Emergency Broadcasting System (EBS) - Used to inform the public about an emergency and the protective actions to take. The EBS is a service of local radio and television stations, activated as needed and approved by a local emergency management agency.

Ecology - The study of the relationships between all living **organisms** and the environment, especially the totality or pattern of interactions; a view that includes all plant and animal species and their unique contributions to a particular habitat.

Ecosystem - The interacting **synergism** of all living **organisms** in a particular environment; every plant, insect, aquatic animal, bird, or land species that forms a complex web of interdependency. An action taken at any level in the food chain, use of a **pesticide** for example, has a potential domino effect on every other occupant of that system.

Effluent - Wastewater **discharged** from a **point source**, such as a pipe.

Effluent Guidelines - Technical documents developed by EPA which set **discharge** limits for particular types of industries and specific pollutants.

Effluent Limitations - Limits on the amounts of pollutants which may be **discharged** by a facility; these limits are calculated so that **water quality standards** will not be violated even at low stream flows.

Emergency and Hazardous Chemical Inventory - An annual report by facilities having one or more **extremely hazardous substances** or hazardous chemicals above certain weight limits, as specified in Section 311 and 312 of **EPCRA**.

Emergency Preparedness Coordinator - The local government official designated to be notified immediately of chemical emergencies (e.g., spills, chemical releases, explosions, or fires) under **EPCRA**.

Emission - The release or **discharge** of a substance into the environment. Generally refers to the release of gases or **particulates** into the air.

Emission Standards - Government standards that establish limits on **discharges** of pollutants into the environment (usually in reference to air).

Endangered Species - Animals, plants, birds, fish, or other living **organisms** threatened with extinction by man-made or natural changes in the environment.

Energy Recovery - To capture energy from waste through any of a variety of processes (e.g., burning). Many new technology **incinerators** are waste-to-energy recovery units.

Environmental Assessment (EA) - A preliminary, written, environmental analysis required by **NEPA** (see the Federal Law section) to determine whether a federal activity such as building airports or highways would significantly affect the environment; may require preparation of more detailed **Environmental Impact Statement**.

Environmental Audit - An independent assessment (not conducted by EPA) of a facility's compliance policies, practices, and controls. Many **pollution prevention** initiatives require an audit to determine where wastes may be reduced or eliminated or energy conserved. Many supplemental environmental projects that offset a penalty use audits to identify ways to reduce the harmful effects of a violation.

Environmental Equity - Equal protection from environmental hazards for individuals, groups, or communities regardless of race, ethnicity, or economic status.

Environmental Impact Statement (EIS) - A document prepared by or for EPA which identifies and analyzes, in detail, environmental impacts of a proposed action. As a tool for decision-making, the EIS describes positive and negative effects and lists alternatives for an undertaking, such as development of a wilderness area. (Required by **NEPA** — see Federal Law Section)

Environmental Justice - The fair treatment of people of all races, cultures, incomes, and educational levels with respect to the development and enforcement of environmental laws, regulations, and policies. Fair treatment implies that no population should be forced to shoulder a disproportionate share of exposure to the negative effects of pollution due to lack of political or economic strength.

Environmental Response Team (ERT) - EPA's group of highly trained scientists and engineers based in Edison, NJ and Cincinnati, OH who back up the federal **On-Scene Coordinator**. The ERT's capabilities include multimedia sampling and analysis, hazard assessment, hazardous substance and oil spill cleanup techniques, and technical support.

Epidemiologist - A medical scientist who studies the various factors involved in the incidence, distribution, and control of disease in a population.

Erosion - The wearing away of soil by wind or water, intensified by land-clearing practices related to farming, residential or industrial development, road building, or logging.

Estuary - A complex ecosystem between a river and near-shore ocean waters where fresh and salt water mix. These brackish areas include bays, mouths of rivers, salt marshes, **wetlands**, and lagoons and are influenced by tides and currents. Estuaries provide valuable habitat for marine animals, birds, and other wildlife.

Explosive Limits (chemical) - The amounts of **vapor** in air that form explosive mixtures. These limits are expressed as lower and upper values and give the range of vapor concentrations in air that will explode if an ignition source is present.

Exposure - Radiation or pollutants that come into contact with the body and present a potential health threat. The most common routes of **exposure** are through the skin, mouth, or by inhalation.

Extremely Hazardous Substances (EHS) - Any of 366 (+ or -) chemicals or hazardous substances identified by **EPA** on the basis of hazard or toxicity and listed under **EPCRA**. The list is periodically revised.

Fecal Coliform Bacteria - Found in the intestinal tracts of mammals, this bacteria in water or sludge is an indicator of pollution and possible contamination by pathogens.

Feedstock - Raw material supplied to a machine or processing plant from which other products can be made. For example, polyvinyl chloride and polyethylene are raw chemicals used to produce plastic tiles, mats, fenders, cushions, and traffic cones.

Financial Assurance - A means (such as insurance, guarantee, surety bond, letter of credit, or qualification as a self-insurer) by the operator of a facility such as a **landfill** to assure financial capability for cleaning up possible environmental releases and **closure** of that facility.

First Draw - The water that comes out when a faucet in the kitchen or bathroom is first opened, which is likely to have the highest level of lead contamination from old plumbing solder and pipes.

Flammable - Describes any material that can be ignited easily and that will burn rapidly.

Flare - A device that burns gaseous materials to prevent them from being released into the environment. Flares may operate continuously or intermittently and are usually found on top of a stack. Flares also burn off methane gas in a landfill.

Flash Point - The lowest temperature at which evaporation of a substance produces enough **vapor** to form an ignitable mixture with air.

Floodplain - Mostly level land along rivers and streams that may be submerged by floodwater. A 100-year floodplain is an area which can be expected to flood once in every 100 years.

Flue Gas Desulfurization - The removal of sulfur oxides from exhaust gases of a boiler or industrial process; usually a wet **scrubbing** operation which concentrates hazardous materials in a slurry, requiring proper **disposal**.

Fugitive Emissions - Air pollutants released to the air other than those from stacks or vents; typically small releases from leaks in plant equipment such as valves, pump seals, flanges, sampling connections, etc.

Fungicide - A **pesticide** used to control or destroy fungi on food or grain crops.

Garbage - Food waste (animal and vegetable) resulting from the handling, storage, packaging, sale, preparation, cooking, and serving of foods.

General Reporting Facility - A facility having one or more hazardous chemicals above the 10,000-pound Threshold Planning Quantity. These facilities must file **Material Safety Data Sheets** and emergency inventory information with the **SERC**, **LEPC**, and local fire departments.

Generator - A facility or mobile source that emits pollutants into the air; any person who produces a hazardous waste that is listed by EPA and therefore subject to regulation.

Genetic Engineering - A process of inserting new genetic information into existing cells in order to modify an **organism** for the purpose of changing particular characteristics.

Global Warming - See definition for **Climate Change**.

Grab Sample - A single sample of soil or of water taken without regard to time or flow.

Greenhouse Effect - See definition for **Climate Change**.

Ground Water - Water found below the surface of the land, usually in porous rock formations. Ground water is the source of water found in wells and springs and is used frequently for drinking.

Hazard Communication Standard - An **OSHA** regulation that requires chemical manufacturers, suppliers, and importers to assess the hazards of the chemicals they make, supply, or import, and to inform employers, customers, and workers of these hazards through a **Material Safety Data Sheet**.

Hazardous Chemical - EPA's designation for any hazardous material that requires a **Material Safety Data Sheet**. Such substances are capable of producing adverse physical effects (fire, explosion, etc.) or adverse health effects (cancer, dermatitis, etc.)

Hazardous Waste - A subset of **solid wastes** that pose substantial or potential threats to public health or the environment and meet any of the following criteria:

- is specifically listed as a hazardous waste by EPA;
- exhibits one or more of the characteristics of hazardous wastes (ignitability, **corrosiveness**, **reactivity**, and/or toxicity);
- is generated by the treatment of hazardous waste; or is contained in a hazardous waste.

Hazardous Waste Landfill - A specially permitted, excavated or engineered area in which **hazardous waste** is deposited and covered. Proper protection of the environment from the materials to be deposited in such a **landfill** requires careful site selection, the cataloging of types of wastes, good design (including a liner and a **leachate** collection and treatment system), proper operation, and thorough final **closure**.

Health Assessment - An evaluation of available data on existing or potential risks posed by a Superfund site. Every site on the National Priorities List has a health assessment prepared by the **Agency for Toxic Substances and Disease Registry** (see Government Agency section).

Heavy Metal - A common **hazardous waste**; can damage **organisms** at low **concentrations** and tends to accumulate in the food chain.

Herbicide - A **pesticide** designed to control or kill plants, weeds, or grasses. Almost 70% of all pesticide used by farmers and ranchers are herbicides. These chemicals have wide-ranging effects on non-target species (other than those the pesticide is meant to control).

Household or **Domestic Waste** - **Solid waste**, composed of **garbage** and rubbish, which normally originates from residential, private households, or apartment buildings. Domestic waste may contain a significant amount of toxic or **hazardous waste** from improperly discarded **pesticides**, paints, batteries, and cleaners.

Hydraulic Gradient - The direction of **ground water** flow due to changes in the depth of the **water table**.

Hydrocarbons - Chemicals that consist entirely of hydrogen and carbon. Hydrocarbons contribute to air pollution problems like **smog**.

Identification Code or EPA I.D. Number - The unique code assigned to each **generator**, transporter, and treatment, storage, or **disposal** facility by EPA to facilitate identification and tracking of **hazardous waste**. **Superfund** sites also have assigned I.D. numbers.

Impoundment - A body of water or **sludge** confined by a dam, dike, floodgate, or other barrier.

Incident Command System (ICS) - An organizational scheme wherein one person, normally the Fire Chief, takes charge of an integrated, comprehensive emergency response. This commander is backed by an Emergency Operations Center which provides support, resources, communications, and advice.

Incineration - The destruction of solid, liquid, or gaseous wastes by controlled burning at high temperatures. Hazardous organic compounds are converted to ash, carbon dioxide, and water. Burning destroys organics, reduces the volume of waste, and vaporizes water and other liquids the wastes may contain. The residue ash produced may contain some hazardous material, such as non-combustible **heavy metals**, concentrated from the original waste.

Incinerator - A furnace for the routine burning of waste materials using controlled flame combustion.

Incompatible Waste - A waste unsuitable for mixing with another waste or material because of **reactivity** hazards.

Indirect Discharge - The introduction of pollutants from a non-domestic source into a publicly owned wastewater treatment system. Indirect dischargers can be commercial or industrial facilities who must pre-treat their wastes before **discharge** into local sewers.

Indoor Air - Breathing air inside a habitable structure, often highly polluted because of lack of exchange with fresh oxygen from outdoors. Solvents, smoke, paints, furniture glues, carpet padding, and other synthetic chemicals trapped inside contribute to an often unhealthy environment.

Industrial Waste - Unwanted materials produced in or eliminated from an industrial operation and categorized under a variety of headings, such as liquid wastes, **sludge**, **solid wastes**, and **hazardous wastes**.

Inert ingredients - Substances that are not "active," such as water, petroleum distillates, talc, corn meal, or soaps. When discussing **pesticides**, inert ingredients do not attack a particular pest, but some are chemically or biologically active, causing health and environmental problems.

Infectious Waste - See definition for **Medical Waste**.

Innovative Technology - New or inventive methods to treat **hazardous wastes**, conserve energy, or prevent **pollution**.

Insecticide - A **pesticide** compound specifically used to kill or prevent the growth of insects.

Integrated Pest Management (IPM) - A combination of biological, cultural, and genetic pest control methods with use of **pesticides** as the last resort. IPM considers a targeted species' life cycle and intervenes in reproduction, growth, or development to reduce the population. Land use practices are examined for possible change; other animals, birds, or reptiles in the ecosystem are used as natural predators.

Interstate Commerce - A clause of the United States Constitution which reserves to the federal government the right to regulate the conduct of business across state lines. Under this clause, the U.S. Supreme Court has ruled that states may not restrict the **disposal** of wastes originating out-of-state more than that of waste originating in-state.

Inversion - An atmospheric condition caused by increasing temperature with elevation, resulting in a layer of warm air preventing the rise of cooler air trapped beneath. This condition prevents the rise of pollutants that might otherwise be dispersed. Trapping pollutants near the ground increases **ozone** to harmful levels.

Irradiated Food - Food that has been briefly exposed to radioactivity (usually gamma rays) to kill insects, bacteria, and mold. Irradiated food can be stored without refrigeration or chemical preservatives and has a long "shelf life."

Irritant - A substance that can cause irritation of the skin, eyes, or respiratory system. An irritant can cause an **acute effect** from a single high-level **exposure**, or **chronic effects** from repeated, low-level exposures. Some examples of irritants are chlorine, nitric acid, and various **pesticides**.

Karst - A geologic formation of irregular limestone deposits with sinks, underground streams, and caverns.

Lagoon - A shallow, artificial treatment pond where sunlight, bacterial action, and oxygen work to purify wastewater; a stabilization pond. An aerated lagoon is a treatment pond that uses oxygen to speed up the natural process of biological decomposition of organic wastes. A lagoon is regulated as a **point source** under the **Clean Water Act** if there is a direct surface water discharge. Some lagoons that discharge into **ground water** also are regulated if they have a direct hydrogeologic connection to surface water. In other areas, lagoons were historically used to dump various liquid, **solid, and hazardous wastes** from manufacturing or industrial processes. These wastes typically flooded and polluted surrounding environs or seeped underground. Such lagoons are now regulated under **RCRA** but some must be cleaned up under **Superfund**.

Land Disposal Restrictions (Land Ban) - Mandated by the 1984 amendments to **RCRA**, prohibits the disposal of hazardous wastes into or on the land.

Landfill - A method for final **disposal** of **solid waste** on land. The refuse is spread and compacted and a cover of soil applied so that effects on the environment (including public health and safety) are minimized. Under current regulations, landfills are required to have liners and **leachate** treatment systems to prevent contamination of **ground water** and **surface waters**. An industrial landfill disposes of non-hazardous **industrial wastes**. A municipal landfill disposes of domestic waste including **garbage**, paper, etc. This waste may include toxins that are used in the home, such as insect sprays and powders, engine oil, paints, solvents, and weed killers.

Large Quantity Generator - Person or facility which generates more than 2,200 pounds of **hazardous waste** per month. In 1989, only 1% of more than 20,000 **generators** fell into this category. Those generators produced nearly 97% of the nation's hazardous waste. These generators are subject to all requirements of **RCRA**.

Leachate - Liquid (mainly water) that percolates through a **landfill** and has picked up dissolved, suspended, and/or microbial contaminants from the waste. Leachate can be compared to coffee: water that has percolated down through the ground coffee.

Lethal Concentration 50 (LC 50) - A **concentration** of a pollutant or **effluent** at which 50% of the test **organisms** die; a common measure of **acute toxicity**.

Lethal Dose 50 (LD 50) - The **dose** of a toxicant that will kill 50% of test organisms within a designated period of time. The lower the LD 50, the more toxic the compound.

Limited Degradation - A policy that allows for some lowering of natural environmental quality to a given level beneath an established health standard.

Liner - Structure of natural clay or manufactured material (plastic) which serves as a barrier to restrict **leachate** from reaching or mixing with **ground water** in **landfills**, **lagoons**, etc.

Litter - The highly visible portion of **solid waste** (usually packaging material) which is generated by the consumer and carelessly discarded outside of the regular **garbage** disposal system, as on the highways or in streets.

Local Emergency Planning Committee (LEPC) - The body appointed by the State Emergency Response Commission **(SERC)**, as required by **EPCRA**, which develops comprehensive emergency plans for Local Emergency Planning Districts, collects **MSDS** forms and chemical release reports, and provides this information to the public. Each county and some large city governments participate in an **LEPC**.

Manifest System - Tracking of **hazardous waste** from "cradle to grave" (generation through **disposal**), with accompanying documents known as "manifests."

Material Safety Data Sheet (MSDS) - Printed material concerning a **hazardous chemical**, or **Extremely Hazardous Substance**, including its physical properties, hazards to personnel, fire and explosion potential, safe handling recommendations, health effects, fire fighting techniques, **reactivity**, and proper **disposal**. Originally established for employee safety by **OSHA**.

Maximum Achievable Control Technology (MACT) - Generally, the best available control technology, taking into account cost and technical feasibility.

Maximum Contaminant Level (MCL) - The maximum level of certain contaminants permitted in drinking water supplied by a **public water system** as set by EPA under the federal **Safe Drinking Water Act.**

Maximum Contaminant Level Goal (MCLG) - The maximum level of a contaminant that is associated with no adverse health effects from drinking water containing that contaminant over a lifetime. For chemicals believed to cause cancer, the MCLGs are set at zero. MCLGs are not enforceable, but are ideal, health-based goals which are set in the National Primary Drinking Water Standards developed by EPA. **MCLs** are set as close to MCLGs as possible, considering costs and technology.

Medical Waste - All wastes from hospitals, clinics, or other health care facilities ("Red Bag Waste") that contain or have come into contact with diseased tissues or infectious **microorganisms**. Also referred to as infectious waste which is **hazardous waste** with infectious characteristics, including: contaminated animal waste, human blood and blood products, pathological waste, and discarded sharps (needles, scalpels, or broken medical instruments).

Microorganisms - Bacteria, yeasts, simple fungi, algae, protozoans, and a number of other organisms that are microscopic in size. Most are beneficial but some produce disease. Others are involved in composting and sewage treatment.

Milligrams/liter (mg/l) - A measure of **concentration** used in the measurement of fluids. Mg/l is the most common way to present a concentration in water and is roughly equivalent to **parts per million**.

Minimization - Measures or techniques that reduce the amount of wastes generated during industrial production processes; this term also is applied to **recycling** and other efforts to reduce the volume of waste going to **landfills**. This term is interchangeable with waste reduction and waste minimization.

Mitigation - Measures taken to reduce adverse effects on the environment.

Monitoring Well - A well used to take water quality samples or to measure **ground water** levels.

Morbidity - Rate of incidence of disease.

Mortality - Death rate.

Mutagenicity - The property of a chemical that causes the genetic characteristics of an **organism** to change in such a way that future generations are permanently affected.

National Ambient Air Quality Standards (NAAQS) - Maximum air pollutant standards that EPA set under the **Clean Air Act** for attainment by each state. The standards were to be achieved by 1975, along with state implementation plans to control industrial sources in each state.

National Emissions Standards for Hazardous Air Pollutants (NESHAP) - **Emission** standards set by EPA for an air pollutant not covered by **NAAQS** that may cause an increase in deaths or serious, irreversible, or incapacitating illness. Primary standards are designed to protect human health, secondary standards to protect public welfare.

National Pollutant Discharge Elimination System (NPDES) - The primary permitting program under the **Clean Water Act** which regulates all **discharges** to **surface water**.

National Priorities List (NPL) - A list of sites, many nominated by the states, for **hazardous waste** cleanup under **Superfund**.

National Response Center (NRC) - The primary communications center operated by the U.S. Coast Guard to receive reports of major chemical and oil spills and other hazardous substances into the environment. The NRC immediately relays reports to a predesignated federal **On-Scene Coordinator**.

National Response Team (NRT) - Representatives from 15 federal agencies with interests and expertise in various aspects of emergency response to pollution incidents. EPA serves as chair and the U.S. Coast Guard serves as vice-chair. The NRT is primarily a national planning, policy, and coordinating body and does not respond directly to incidents. The NRT provides policy guidance prior to an incident and assistance as requested by a federal **On-Scene Coordinator** via a **Regional Response Team** during an incident. NRT assistance usually takes the form of technical advice, access to additional resources or equipment, or coordination with other RRTs.

National Strike Force (NSF) - Operated by the U.S. Coast Guard, the NSF is composed of three strategically located teams (Atlantic, Pacific, and Gulf coasts) who back up the federal **On-Scene Coordinator**. These teams are extensively trained and equipped to respond to major oil spills and chemical releases. These capabilities are especially suited to incidents in a marine environment but also include site assessment, safety, action plan development, and documentation for both inland and coastal zone incidents. The NSF Coordination Center is at Elizabeth City, NC.

Neutralization - The chemical process in which the **acidic** or basic characteristics of a fluid are changed to those of water (**pH** = 7).

Non-Attainment - Refers to areas of the United States that have not met air standards for human health by deadlines set in the **Clean Air Act**.

Non-Contact Cooling Water - Water used for cooling which does not come into direct contact with any raw material, product, **by-product**, or waste.

Non-Degradation - A policy that forbids any lowering of naturally occurring environmental quality regardless of established health standards.

Nonpoint Source - Any source of **pollution** not associated with a distinct **discharge** point. Includes sources such as rainwater, runoff from agricultural lands, industrial sites, parking lots, and timber operations, as well as escaping gases from pipes and fittings.

No Observed Adverse Effect Level or **No Observed Effect Level (NOAEL)** or **(NOEL)** A level of **exposure** which does not cause observable harm.

Odor Threshold - The lowest **concentration** of a substance in air that can be smelled. Odor thresholds are highly variable because of the differing ability of individuals to detect odors.

On-Scene Coordinator (OSC) - The federal official responsible for the coordination of a hazardous materials response action, as specified in individual Regional Contingency Plans. OSCs are predesignated by EPA for inland areas and by the U.S. Coast Guard for coastal areas. The OSC coordinates all federal containment, removal, and disposal efforts and resources during a pollution incident. The OSC is the point of contact for the coordination of federal efforts with those of the local response community. The OSC has access to extensive federal resources, including the **National**

Strike Force, the **Environmental Response Team**, and **Scientific Support Coordinators**. The OSC can be a source of valuable support and information to the community.

On Site - On the same, or adjacent, property.

Organically Grown - Food, feed crops, and livestock grown within an intentionally-diversified, self-sustaining agro-ecosystem. In practice, farmers build up nutrients in the soil using **compost**, agricultural wastes, and cover crops instead of synthetically derived fertilizers to increase productivity, rotate crops, weed mechanically, and reduce dramatically their dependence on the entire family of **pesticides**. Farmers must be certified to characterize crops as organically grown and can only use approved natural and synthetic **biochemicals**, agents, and materials for three consecutive years prior to harvest. Livestock must be fed a diet that includes grains and forages that have been organically grown and cannot receive hormones, sub-therapeutic antibiotics, or other growth promoters.

Organism - Any living being, whether plant, mammal, bird, insect, reptile, fish, crustacean, aquatic or estuarine animal, or bacterium.

Oxidant - A substance containing oxygen that reacts chemically with other materials to produce new substances. Oxidants are the primary ingredients in **smog**.

Ozone - Three molecule oxygen compound (O3) found in two layers of the earth's atmosphere. One layer of beneficial ozone occurs at seven to 18 miles above the surface and shields the earth from ultraviolet light. Several holes in this protective layer have been documented by scientists. Ozone also concentrates at the surface as a result of reactions between **by-products** of fossil fuel combustion and sunlight, having harmful health effects.

Particulates - Liquid or solid particles such as dust, smoke, mist, or smog found in air **emissions**.

Parts per billion (ppb) - One ppb is comparable to one kernel of corn in a filled, 45-foot silo, 16 feet in diameter.

Parts per million (ppm) - One ppm is comparable to one drop of gasoline in a tankful of gas (full-size car).

Parts per trillion (ppt) - One ppt is comparable to one drop in a swimming pool covering the area of a football field 43 ft. deep.

Pathogen - A bacterial **organism** typically found in the intestinal tracts of mammals, capable of producing disease.

Performance Bond - Cash or securities, deposited before a **landfill** operating **permit** is issued, which are held to ensure that all requirements for operating a landfill are performed. The money is returned to the owner after proper closure of the landfill is complete. If contamination or other problems appear at any time during operation, or upon **closure**, and are not addressed, the owner must forfeit all or part of the performance bond which is then used to cover costs of cleanup.

Permeability - The ease with which water, or other fluid, passes through a substance.

Permissible Exposure Limit (PEL) - Workplace **exposure** limits for contaminants established by **OSHA**.

Permit - A legal document issued by state and/or federal authorities containing a detailed description of the proposed activity and operating procedures as well as appropriate requirements and regulations. The permitting process includes provisions for public comment.

Pesticide - Substances intended to repel, kill, or control any species designated a "pest" including weeds, insects, rodents, fungi, bacteria, or other organisms. The family of pesticides includes **herbicides**, **insecticides**, **rodenticides**, **fungicides**, and **bactericides**.

pH - The measure of acidity or **alkalinity** of a chemical solution, from 0–14. Anything neutral, for example, has a pH of 7. **Acids** have a pH less than 7, bases (alkaline) greater than 7.

Plume - A **concentration** of contaminants in air, soil, or water usually extending from a distinct source.

Point Source - A stationary location or fixed facility such as an industry or municipality that **discharges** pollutants into air or **surface water** through pipes, ditches, **lagoons**, wells, or stacks; a single identifiable source such as a ship or a mine.

Pollution - Any substances in water, soil, or air that degrade the natural quality of the environment, offend the senses of sight, taste, or smell, or cause a health hazard. The usefulness of the natural resource is usually impaired by the presence of pollutants and contaminants.

Pollution Prevention - Actively identifying equipment, processes, and activities which generate excessive wastes or use **toxic chemicals** and then making substitutions, alterations, or product improvements. Conserving energy and minimizing wastes are pollution prevention concepts used in manufacturing, **sustainable agriculture**, **recycling**, and clean air/clean water technologies.

Polychlorinated Biphenyls (PCBs) - A group of toxic, persistent chemicals used in electrical transformers and capacitors for insulating purposes, and in gas pipeline systems as a lubricant. The sale and new use of **PCBs** were banned by law in 1979.

Potable Water - Raw or treated water that is considered safe to drink.

Potentially Responsible Party (PRP) - Any individual or company that is potentially responsible for or has contributed to a spill or other contamination at a **Superfund** site. Whenever possible, **EPA** requires PRPs to clean up sites they have contaminated.

Pretreatment - Methods used by industry and other non-household sources of wastewater to remove, reduce, or alter the pollutants in wastewater before **discharge** to a **POTW**.

Primary Treatment - First stage of wastewater treatment in which solids are removed by screening and settling.

Process Wastewater - Any water which comes into contact with any raw material, product, **by-product**, or waste.

Public Comment Period - The time allowed for the members of an affected community to express views and concerns regarding an action proposed to be taken by EPA, such as a rulemaking, permit, or **Superfund** remedy selection.

Public Water System - Any water system that regularly supplies piped water to the public for consumption, serving at least an average of 25 individuals per day for at least 60 days per year, or has at least 15 service connections.

Publicly Owned Treatment Works (POTW)
A municipal or public service district sewage treatment system.

Quality Assurance/Quality Control - A system of procedures, checks, audits, and corrective actions to ensure that all technical, operational, monitoring, and reporting activities are of the highest achievable quality.

Quench Tank - A water-filled tank used to cool incinerator residue or hot materials from industrial processes.

Radioactive Waste - Any waste that emits energy as rays, waves, or streams of energetic particles. Radioactive materials are often mixed with **hazardous waste**, usually from nuclear reactors, research institutions, or hospitals.

Radon - A colorless, naturally occurring gas formed by radioactive decay of radium atoms. Radon accumulating in basements and other areas of buildings without proper ventilation has been identified as a leading cause of lung cancer.

Raw Water - Intake water prior to any treatment or use.

Reactivity - Refers to those **hazardous wastes** that are normally unstable and readily undergo violent chemical change but do not explode.

Receiving Waters - A river, lake, ocean, stream, or other body of water into which wastewater or treated **effluent** is **discharged**.

Recharge Area - An area of land where there is a net annual transfer of water from the surface to **ground water**; where rainwater soaks through the earth to reach an aquifer.

Recycling - Reusing materials and objects in original or changed forms rather than discarding them as wastes.

Record of Decision (ROD) - A public document that explains which cleanup alternative was selected for a **Superfund** site.

Red Bag Waste - see definition for **Medical Waste**.

Reference Dose (RfD) - The particular concentration of a chemical that is known to cause health problems. A standard that also may be referred to as the acceptable daily intake.

Refine - To remove impurities.

Regional Response Team (RRT) - There are 13 RRTs, one for each of 10 federal regions, plus one for Alaska, one for the Caribbean, and one for the Pacific Basin. Each RRT maintains a Regional Contingency Plan and has state and federal government representation. EPA and the U.S. Coast Guard cochair the RRTs. Like the **NRT**, RRTs are planning, policy, and coordinating bodies and do not respond directly to pollution incidents but do provide assistance when requested by the federal **On-Scene Coordinator**. RRTs also provide assistance to **SERCs** and **LEPCs** in local preparedness, planning, and training for emergency response.

Registration - Formal listing with EPA of a new **pesticide** before sale or distribution. EPA is responsible for pre-market licensing of pesticides on the basis of data demonstrating no unreasonable adverse health or environmental effects when applied according to approved label directions.

Release - Any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment of a **hazardous** or **toxic chemical**, or **extremely hazardous substance**.

Remedial Action - The actual construction or clean-up phase of a **Superfund** site cleanup.

Reportable Quantity (RQ) - Amount of a hazardous or **extremely hazardous substance** that, if released into the environment, must be reported to the **NRC**, the **SERC**, and the **LEPC** under Section 304 of **EPCRA**.

Residual Risk - The risk associated with pollutants after the application of maximum achievable control technology or **MACT**.

Resource Recovery - The extraction of useful materials or energy from solid waste. Such materials can include paper, glass, and metals that can be reprocessed for re-use. Resource recovery also is employed in **pollution prevention**.

Responsiveness Summary - A summary of oral and written comments received by EPA during a **public comment period** on key documents or actions proposed to be taken, and EPA's response to those comments.

Risk - A measure of the chance that damage to life, health, property, or the environment will occur.

Risk Assessment - A process to determine the increased **risk** from exposure to environmental pollutants together with an estimate of the severity of impact. Risk assessments use specific chemical information plus risk factors.

Risk Communication - The process of exchanging information about levels or significance of health or environmental **risk**.

Risk Factor - A characteristic (e.g., race, sex, age, obesity) or variable (e.g., smoking, **exposure**) associated with increased chance of toxic effects. Some standard risk factors used in general **risk assessment** calculations include average breathing rates, average weight, and average human life span.

Rodenticide - A **pesticide** or other agent used to kill rats and other rodents or to prevent them from damaging food, crops, or forage.

Sanitary Water - Water discharged from restrooms, showers, food preparation facilities, or other nonindustrial operations; also known as "gray water."

Scientific Support Coordinators (SSC) - Scientific and technical advisors in coastal and marine areas from the National Oceanic and Atmospheric Administration (NOAA) who serve as members of the federal **On-Scene Coordinator**'s staff. Their capabilities include contingency planning, surface/subsurface trajectory forecasting and hindcasting, resource risk analysis, and liaison to other scientists.

Scrubbing - A common method of reducing stack air emissions; removal of impurities by spraying a liquid that concentrates the impurities into waste.

Secondary Treatment - The second step taken by a **Publicly Owned Treatment Works** in which bacteria consume the organic parts of the waste. This treatment usually removes about 90% of all solids and oxygen-demanding substances.

Sediment - Topsoil, sand, and minerals washed from the land into water, usually after rain or snow melt. Sediments collecting in rivers, reservoirs, and harbors can destroy fish and wildlife habitat and cloud the water so that sunlight cannot reach aquatic plants. Loss of topsoil from farming, mining, or building activities can be prevented through a variety of **erosion**-control techniques.

Septic tank - An underground tank to collect wastes from homes that are not connected to a municipal sewer system. Waste goes from the home to the tank and is decomposed by bacteria. Solids and dead bacteria settle to the bottom as **sludge** while the liquid portion flows into the ground through drains. While properly placed and maintained septic systems can effectively treat domestic wastewater, others are a major source of **ground water** and **surface water pollution**.

Sewer - A channel or conduit that carries wastewater and stormwater to a treatment plant or **receiving waters**. "Sanitary" sewers carry household, industrial, and commercial waste. "Storm" sewers carry runoff from rain or snow.

Siting - Choosing a location for a facility.

Sludge - The residue (solids and some water) produced as a result of raw or wastewater treatment.

Slurry - A pumpable mixture of solids and fluid.

Small Quantity Generator (SQG) - Persons or facilities that produce 220–2,200 pounds per month of **hazardous waste**. SQGs are required to keep more records than **conditionally exempt generators**. SQGs may include automotive shops, dry cleaners, photographic developers, and a host of other small enterprises. SQGs comprise by far the vast majority of hazardous waste **generators**.

Smog - Dust, smoke, or chemical fumes that pollute the air and make hazy, unhealthy conditions (literally, the word is a blend of smoke and fog). Automobile, truck, bus, and other vehicle exhausts and **particulates** are usually trapped close to the ground, obscuring visibility and contributing to a number of respiratory problems.

Solid Waste - As defined under **RCRA**, any solid, semi-solid, liquid, or contained gaseous materials discarded from industrial, commercial, mining, or agricultural operations, and from community activities. Solid waste includes **garbage**, construction debris, commercial refuse, **sludge** from water supply or waste treatment plants, or air pollution control facilities, and other discarded materials.

Solid Waste Management Facility - Any **disposal** or **resource recovery** system; any system, program, or facility for resource conservation; any facility for the treatment of **solid wastes**.

Source Reduction - The design, manufacture, purchase, or use of materials (such as products and packaging) to reduce the amount or toxicity of **garbage** generated. Source reduction can help reduce waste **disposal** and handling charges because the costs of **recycling**, municipal composting, landfilling, and combustion are avoided. Source reduction conserves resources and reduces **pollution**.

Source Separation - Organizing materials by type (such as paper, metal, plastic, and glass) so that these items can be **recycled** instead of thrown away. For example, many of us separate these items from the rest of our household and office wastes. Industries also organize materials in this fashion.

Standard Industrial Classification Code (SIC Code) - A method of grouping industries with similar products or services and assigning codes to these groups.

State Emergency Response Commission (SERC) - The agency appointed by the Governor to oversee the administration of **EPCRA** at the state level. This commission designates and appoints members to **LEPCs** and reviews emergency response plans for cities and counties.

Surface Impoundment - Treatment, storage, or disposal of liquid **hazardous wastes** in ponds.

Surface Water - All water naturally open to the atmosphere (rivers, lakes, reservoirs, ponds, streams, seas, estuaries) and all springs, wells, or other collectors directly influenced by surface water.

Surfactant - A detergent compound that promotes lathering.

Suspended Solids - Solids that either float on the surface or are suspended in water, wastewater, or other liquids.

Sustainable Agriculture - Environmentally friendly methods of farming that allow the production of crops or livestock without damage to the farm as an **ecosystem**, including effects on soil, water supplies, **biodiversity**, or other surrounding natural resources. The concept of sustainable agriculture is an "intergenerational" one in which we pass on a conserved or improved natural resource base instead of one which has been depleted or polluted. Terms often associated with farms or ranches that are self-sustaining include "low-input," **organic**, "ecological," "biodynamic," and "permaculture."

Synergism - The cooperative action of two or more **organisms** producing a greater total result than the sum of their independent effects; chemicals or muscles in synergy enhance the effectiveness of one another beyond what an individual could have produced.

Technical Assistance Grant (TAG) - EPA grants of up to $50,000 for citizens' groups to obtain assistance in interpreting information related to cleanups at **Superfund** sites. Grants are used by such groups to hire technical advisors to help them understand the site-related information for the duration of response activities.

Ten-to-the-Minus-Sixth (10^{-6}) - Used in **risk assessments** to refer to the probability of **risk**. Literally means a chance of one in a million. Similarly, ten-to-the-minus-fifth means a probability of one in 100,000, and so on.

Teratogen - A substance capable of causing birth defects.

Tertiary Treatment - An enhancement of normal sewage treatment operations to provide water of **potable** quality using further chemical and physical treatment; the highest drinking water standard achieved in the U.S.

Threshold Limit Value (TLV) - The **concentration** of an airborne substance that a healthy person can be exposed to for a 40-hour work week without adverse effect; a workplace **exposure** standard.

Tolerance - Permissible residue level for **pesticides** in raw agricultural produce and processed foods. Whenever a pesticide is registered for use on a food or feed crop, a tolerance must be established. EPA establishes the tolerance levels, which are enforced by the Food and Drug Administration and the Department of Agriculture.

Tonnage - The amount of waste that a **landfill** accepts, usually expressed as tons per month. The rate at which a landfill accepts waste is limited by the landfill's **permit**.

Total dissolved solids (TDS) - The quantity of dissolved material in a given volume of water.

Toxic Chemical - Substances that can cause severe illness, poisoning, birth defects, disease, or death when ingested, inhaled, or absorbed by living **organisms**.

Toxic Cloud - An airborne mass of gases, **vapors**, fumes, or aerosols of toxic materials.

Toxic Release Inventory (TRI) - A database of annual toxic releases from certain manufacturers compiled from **EPCRA** Section 313 reports. Manufacturers must report annually to EPA and the states the amounts of almost 350 **toxic chemicals** and 22 chemical categories that they release directly to air, water, or land, inject underground, or transfer to off-site facilities. EPA compiles these reports and makes the information available to the public under the "Community Right-to-Know" portion of the law.

Toxic Substance - A chemical or mixture that can cause illness, death, disease, or birth defects. The quantities and **exposures** necessary to cause these effects can vary widely. Many toxic substances are pollutants and contaminants in the environment.

Toxicity Characteristic Leaching Procedure (TCLP) - A test designed to determine whether a waste is hazardous or requires treatment to become less hazardous; also can be used to monitor treatment techniques for effectiveness.

Toxicity Testing - Biological testing (usually with an invertebrate, fish, or small mammal) to determine the adverse effects, if any, of a chemical, compound, or **effluent**.

Trade Secret - Any confidential formula, pattern, process, device, information, or set of data that is used in a business to give the owner a competitive advantage. Such information may be excluded from public review.

Treatment, Storage, and Disposal Facility (TSD) - Refers to any facility which treats, stores, or disposes of **hazardous wastes**.

Ultraviolet Rays - Radiation from the sun in the invisible portion of the spectrum. Some UV rays (UV-A) enhance plant life and are useful in certain medical and dental procedures. Other UV rays (UV-B) can cause skin cancer or other tissue damage. The **ozone** layer in the atmosphere partly shields us from ultraviolet rays reaching the earth's surface.

Underground Injection Control (UIC) - A program under the Safe Drinking Water Act that regulates the use of wells to pump fluids underground.

Underground Storage Tank (UST) - A tank and any underground piping connected to the tank that has 10% or more of its volume (including pipe volume) beneath the surface of the ground. USTs are designed to hold gasoline, other petroleum products, and hazardous materials.

Vapor - The gas given off by substances that are solids or liquids at ordinary atmospheric pressure and temperatures.

Vapor Dispersion - The movement of **vapor** clouds or **plumes** in the air due to wind, gravity, spreading, and mixing.

Vapor Recovery System - A system by which the **volatile** gases from gasoline are captured instead of being released into the atmosphere. Recovery systems may be required for gasoline stations in some cities and other **non-attainment** areas.

Vent - The connection and piping through which gases enter and exit a piece of equipment.

Volatile - Any substance which evaporates quickly.

Volatile Organic Compounds (VOC) - Any organic compound which evaporates readily to the atmosphere. **VOCs** contribute significantly to photochemical **smog** production and certain health problems.

Wasteload Allocation (WLA) - The portion of a stream's total **assimilative capacity** assigned to an individual discharger.

Wastewater Treatment Plant - A facility containing a series of tanks, screens, filters, and other processes by which pollutants are removed from water. Most treatments include **chlorination** to attain safe drinking water standards.

Water Quality Standard (WQS) - The combination of a designated use and the maximum concentration of a pollutant which will protect that use for any given body of water. For example, in a trout stream, the concentration of iron should not exceed 1 mg/l.

Water Table - The boundary between the saturated and unsaturated zones. Generally, the level to which water will rise in a well (except artesian wells).

Wellhead Protection Area - A protected surface and subsurface zone surrounding a well or well field that supplies a public water system and through which contaminants could likely reach well water.

Wetlands - Areas that are soaked or flooded by **surface** or **ground water** frequently enough or for sufficient duration to support plants, birds, animals, and aquatic life. Wetlands generally include swamps, marshes, bogs, estuaries, and other inland and coastal areas, and are federally protected. Wetlands frequently serve as **recharge/discharge** areas and are known as "nature's kidneys" since they help purify water. Wetlands also have been referred to as natural sponges that absorb flood waters, functioning like natural tubs to collect overflow. Wetlands are important wildlife habitats, breeding grounds, and nurseries because of their **biodiversity**. Many **endangered species** as well as countless estuarine and marine fish and shellfish, mammals, waterfowl, and other migratory birds use wetland habitat for growth, reproduction, food, and shelter. Wetlands are among the most fertile, natural **ecosystems** in the world since they produce great volumes of food (plant material).

Wildlife Refuge - An area designated for the protection of wild animals, within which hunting and fishing are either prohibited or strictly controlled.

Wood Treatment Facility - An industrial facility which treats lumber and other wood products for outdoor use. The process involves use of chromated copper arsenate and other **toxic chemicals** which are regulated as hazardous materials.

Xenobiotic - A term for non-natural or man-made substances found in the environment (i.e., synthetics, plastics).

Z-list - **OSHA's** Toxic and Hazardous Substances Tables (Z-1, Z-2, and Z-3) of air contaminants; any material found on these tables is considered hazardous.

Zone of Saturation - The layer beneath the surface of the land in which all openings are filled with water.

major environmental laws

If you are interested in becoming active in environmental, health, and community safety issues, you will need to understand many of the following federal laws. These laws, and others enacted by states, have various requirements and are enforced by various agencies. We have presented a brief description of the intent of each law. For more details, you should obtain a copy from your local library, state library, or the relevant federal or state agency. Federal and state officials, community organizations, and interest groups will help you gain a working knowledge of these laws.

the clean air act (CAA)

42 U.S.C. s/s 7401 et seq. (1970)

The Clean Air Act is the comprehensive federal law which regulates air **emissions** from area, stationary, and mobile sources. This law authorizes the U.S. Environmental Protection Agency (EPA) to establish National Ambient Air Quality Standards **(NAAQS)** to protect public health and the environment. The goal of the Act was to set and achieve NAAQS in every state by 1975. This setting of maximum pollutant standards was coupled with directing the states to develop state implementation plans (SIPs) applicable to appropriate industrial sources in the state.

The Act was amended in 1977 primarily to set new goals (dates) for achieving attainment of NAAQS since many areas of the country had failed to meet the deadlines. The 1990 amendments to the Clean Air Act in large part were intended to meet unaddressed or insufficiently addressed problems such as **acid rain**, ground level **ozone**, stratospheric **ozone** depletion, and air toxics.

the clean water act (CWA)

33 U.S.C. s/s 121 et seq. (1977)

The **Clean Water Act** is a 1977 amendment to the Federal Water Pollution Control Act of 1972, which set the basic structure for regulating **discharges** of pollutants to waters of the United States. This law gave **EPA** the authority to set **effluent** standards on an industry-by-industry basis (technology-based) and continued the requirements to set **water quality standards** for all contaminants in surface waters. The CWA makes it unlawful for any person to **discharge** any pollutant from a **point source** into navigable waters unless a **permit (NPDES)** is obtained under the Act. The 1977 amendments focused on toxic pollutants. In 1987, the CWA was reauthorized and again focused on **toxic substances**, authorized citizen suit provisions, and funded sewage treatment plants **(POTWs)** under the Construction Grants Program.

The **CWA** provides for the delegation by **EPA** of many permitting, administrative, and enforcement aspects of the law to state governments. In states with the authority to implement CWA programs, EPA still retains oversight responsibilities.

the comprehensive environmental response, compensation, and liability act (CERCLA or Superfund)

42 U.S.C. s/s 9601 et seq. (1980)

CERCLA (pronounced SERK-la) provides a federal "Superfund" to clean up uncontrolled or abandoned **hazardous waste** sites as well as accidents, spills, and other emergency releases of pollutants and contaminants into the environment. Through the Act, EPA was given power to seek out those parties responsible for any release and assure their cooperation in the cleanup. EPA cleans up orphan sites when **potentially responsible parties (PRPs)** cannot be identified or located, or when they fail to act. Through various enforcement tools, EPA obtains private party cleanup through orders, **consent decrees**, and other small party settlements. EPA also recovers costs from financially viable individuals and companies once a response action has been completed.

EPA is authorized to implement the Act in all 50 states and U.S. territories. **Superfund** site identification, monitoring, and response activities in states are coordinated through the state environmental protection or waste management agencies.

the emergency planning & community right-to-know act (EPCRA)

42 U.S.C. 11011 et seq. (1986)

Also known as Title III of **SARA**, EPCRA was enacted by Congress as the national legislation on community safety. This law was designed to help local communities protect public health, safety, and the environment from chemical hazards.

To implement EPCRA, Congress required each state to appoint a State Emergency Response Commission **(SERC)**. The SERCs were required to divide their states into Emergency Planning Districts and to name a Local Emergency Planning Committee **(LEPC)** for each district. Broad representation by fire fighters, health officials, government and media representatives, community groups, industrial facilities, and emergency managers ensures that all necessary elements of the planning process are represented.

the endangered species act

7 U.S.C. 136; 16 U.S.C. 460 et seq. (1973)

The Endangered Species Act provides a program for the conservation of threatened and endangered plants and animals and the habitats in which they are found. The U.S. Fish and Wildlife Service (FWS) of the Department of Interior maintains the list of 632 endangered species (326 are plants) and 190 threatened species (78 are plants). Species include birds, insects, fish, reptiles, mammals, crustaceans, flowers, grasses, and trees. Anyone can petition FWS to include a species on this list or to prevent some activity, such as logging, mining, or dam building. The law prohibits any action, administrative or real, that results in a "taking" of a listed species, or adversely affects habitat. Likewise, import, export, interstate, and foreign commerce of listed species are all prohibited.

EPA's decision to register a **pesticide** is based in part on the **risk** of adverse effects on endangered species as well as environmental fate (how a pesticide will effect habitat). Under **FIFRA**, EPA can issue emergency suspensions of certain pesticides to cancel or restrict their use if an endangered species will be adversely affected. Under a new program, EPA, FWS, and USDA are distributing hundreds of county bulletins which include habitat maps, pesticide use limitations, and other actions required to protect listed species.

In addition, we are enforcing regulations under various treaties, including the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). The U.S. and 70 other nations have established procedures to regulate the import and export of imperiled species and their habitat. The Fish and Wildlife Service works with U.S. Customs agents to stop the illegal trade of species, including the Black Rhino, African elephants, tropical birds and fish, orchids, and various corals.

the federal insecticide, fungicide and rodenticide act (FIFRA)

7 U.S.C. s/s 135 et seq. (1972)

The primary focus of FIFRA was to provide federal control of **pesticide** distribution, sale, and use. EPA was given authority under FIFRA not only to study the consequences of pesticide usage but also to require users (farmers, utility companies, and others) to register when purchasing pesticides. Through later amendments to the law, users also must take exams for certification as applicators of pesticides. All pesticides used in the U.S. must be registered (licensed) by EPA. Registration assures that pesticides will be properly labeled and that, if used in accordance with specifications, will not cause unreasonable harm to the environment.

the (federal) freedom of information act (FOIA)

U.S.C. s/s 552 (1966)

The Freedom of Information Act provides specifically that "any person" can make requests for government information. Citizens who make requests are not required to identify themselves or explain why they want the information they have requested. The position of Congress in passing FOIA was that the workings of government are "for and by the people" and that the benefits of government information should be made available to everyone.

All branches of the federal government must adhere to the provisions of FOIA with certain restrictions for work in progress (early drafts), enforcement confidential information, classified documents, and national security information.

the national environmental policy act (NEPA)

42 U.S.C. s/s 4321 et seq. (1969)

The National Environmental Policy Act was one of the first laws ever written that establishes the broad national framework for protecting our environment. NEPA's basic policy is to assure that all branches of government give proper consideration to the environment prior to undertaking any major federal action which significantly affects the environment. NEPA requirements are invoked when airports, buildings, military complexes, highways, parkland purchases, and other such federal activities are proposed. **Environmental Assessments (EAs)** and **Environmental Impact Statements (EISs)**, which are assessments of the likelihood of impacts from alternative courses of action, are required from all federal agencies and are the most visible NEPA requirements.

the occupational safety and health act

29 U.S.C. 61 et seq. (1970)

Congress passed the Occupational and Safety Health Act to ensure worker and workplace safety. Their goal was to make sure employers provide their workers a place of employment free from recognized hazards to safety and health, such as exposure to **toxic chemicals**, excessive noise levels, mechanical dangers, heat or cold stress, or unsanitary conditions. In order to establish standards for workplace health and safety, the Act also created the National Institute for Occupational Safety and Health (**NIOSH**) as the research institution for the Occupational Safety and Health Administration (**OSHA**). OSHA is a division of the U.S. Department of Labor which oversees the administration of the Act and enforces federal standards in all 50 states.

the oil pollution act of 1990

33 U.S.C. Section 2702 to 2761

The Oil Pollution Act (OPA) of 1990 streamlined and strengthened EPA's ability to prevent and respond to catastrophic oil spills. A trust fund financed by a tax on oil is available to clean up spills when the responsible party is incapable or unwilling to do so. The OPA requires oil storage facilities and vessels to submit to the federal government response plans detailing how they will respond to large discharges. EPA has published regulations for aboveground storage facilities; the Coast Guard has done so for oil tankers. The OPA also requires the development of Area Contingency Plans to prepare and plan for oil spill response on a regional scale.

the pollution prevention act

42 U.S.C. 13101 and 13102, s/s 6602 et seq. (1990)

The Pollution Prevention Act focused industry, government, and public attention on reducing the amount of pollution produced through cost-effective changes in production, operation, and raw materials use. Opportunities for source reduction are often not realized because existing regulations, and the industrial resources required for compliance, focus on treatment and disposal. Source reduction is fundamentally different and more desirable than waste management or pollution control. Pollution prevention also includes other practices that increase efficiency in the use of energy, water, or other natural resources, and protect our resource base through conservation. Practices include **recycling**, **source reduction**, and **sustainable agriculture**.

the resource conservation and recovery act (RCRA)

42 U.S.C. s/s 321 et seq. (1976)

RCRA (pronounced "rick-rah") gave EPA the authority to control hazardous waste from "cradle-to-grave." This includes the generation, transportation, treatment, storage, and disposal of hazardous waste. RCRA also set forth a framework for the management of non-hazardous solid wastes.

The 1986 amendments to RCRA enabled EPA to address environmental problems that could result from underground tanks storing petroleum and other hazardous substances. RCRA focuses only on active and future facilities and does not address abandoned or historical sites (see **CERCLA**).

HSWA (pronounced "hiss-wa") - The federal Hazardous and Solid Waste Amendments. The 1984 amendments to **RCRA** which required phasing out land **disposal** of **hazardous waste**. Some of the other mandates of this strict law include increased enforcement authority for **EPA**, more stringent hazardous waste management standards, and a comprehensive **underground storage tank** program.

the safe drinking water act (SDWA)

43 U.S.C. s/s 300f et seq. (1974)

The Safe Drinking Water Act was established to protect the quality of drinking water in the U.S. This law focuses on all waters actually or potentially designated for drinking use, whether from above ground or underground sources. The Act authorized EPA to establish safe standards of purity and required all owners or operators of public water systems to comply with primary (health-related) standards. State governments, which assume this power from EPA, also encourage attainment of secondary standards (nuisance-related).

the superfund amendments and reauthorization act (SARA)

42 U.S.C. 9601 et seq. (1986)

The Superfund Amendments and Reauthorization Act of 1986 reauthorized **CERCLA** to continue cleanup activities around the country. Several site-specific amendments, definitions, clarifications, and technical requirements were added to the legislation, including additional enforcement authorities.

Title III of **SARA** also authorized the Emergency Planning and Community Right-to-Know Act (**EPCRA**).

the toxic substances control act (TSCA)

15 U.S.C. s/s 2601 et seq. (1976)

The Toxic Substances Control Act of 1976 was enacted by Congress to test, regulate, and screen all chemicals produced or imported into the U.S. Many thousands of chemicals and their compounds are developed each year with unknown toxic or dangerous characteristics. To prevent tragic consequences, TSCA requires that any chemical that reaches the consumer market place be tested for possible toxic effects prior to commercial manufacture.

Any existing chemical that poses health and environmental hazards is tracked and reported under TSCA. Procedures also are authorized for corrective action under TSCA in cases of cleanup of toxic materials contamination. TSCA supplements other federal statutes, including the **Clean Air Act** and the **Toxic Release Inventory** under **EPCRA**.

government agencies

Throughout this handbook we have referred to organizations, agencies, and offices to contact for further information. The following is a list of several of those organizations and agencies dealing with health and environmental protection. For each citation, a current address and phone number are provided, as well as a brief notation of responsibilities and/or interests of the group. This list is provided for quick reference when specific issues arise but is by no means complete.

federal agencies for health & environmental protection

U.S. Environmental Protection Agency (EPA)
401 M Street, S.W.
Washington, DC 20460
(202) 260-2080

Public Information Center, open 9 AM to 4:30 PM, Monday – Friday

Responsible for: working with state and local governments to control and prevent pollution in areas of solid and hazardous waste, pesticides, water, air, drinking water, and toxic and radioactive substances. When contacting EPA, we suggest starting with your Regional Office. If the Regional Office is unable to assist you, your questions may be directed to EPA Headquarters in Washington, DC.

U.S. EPA regional offices

Region 1

U.S. EPA (Connecticut, Massachusetts, Maine, New Hampshire, Rhode Island, Vermont)

JFK Federal Building
1 Congress Street
Boston, MA 02203
617/565-3420

Region 2

U.S. EPA (New Jersey, New York, Puerto Rico, Virgin Islands)

26 Federal Plaza
New York, NY 10278
212/264-2657

Region 3

U.S. EPA (Delaware, Maryland, Pennsylvania, Virginia, West Virginia, District of Columbia)

841 Chestnut Building
Philadelphia, PA 19107
215/597-2176

Region 4

U.S. EPA (Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee)

345 Courtland Street, NE
Atlanta, GA 30365
404/347-3004

Region 5

U.S. EPA (Illinois, Indiana, Michigan, Minnesota, Ohio, Wisconsin)

77 West Jackson
Chicago, IL 60604
312/353-2000

Region 6

U.S. EPA (Arkansas, Louisiana, New Mexico, Oklahoma, Texas)

1445 Ross Avenue
Dallas, TX 75202
214/655-6444

Region 7

U.S. EPA (Iowa, Kansas, Missouri, Nebraska)

726 Minnesota Avenue
Kansas City, KS 66401
913/551-7000

Region 8

U.S. EPA (Colorado, Montana, North Dakota, South Dakota, Utah, Wyoming)

999 18th Street
Denver, CO 80202-2466
303/293-1603

Region 9

U.S. EPA (Arizona, California, Hawaii, Nevada, Guam, American Samoa)

75 Hawthorne Street
San Francisco, CA 94105
415/744-1305

Region 10

U.S. EPA (Idaho, Washington, Oregon, Alaska)

1200 Sixth Avenue
Seattle, WA 98101
206/553-1200

U.S. department of justice (DOJ)

10th and Constitution Ave., N.W.
Washington, D.C. 20530
202/514-2007

Responsible for: all enforcement actions that must be filed in court, and organizing evidentiary and other documents to prepare for and conduct litigation. Litigation includes the protection, use, and development of the nation's natural resources and public lands, wildlife protection, Indian rights and claims, cleanup of hazardous waste sites, acquisition of private property for federal use, and defense of environmental challenges to government programs and activities. DOJ's Environment and Natural Resources Division is the nation's environmental lawyer and the largest environmental law firm in the country.

U.S. department of transportation (DOT)

400 7th Street, S.W.
Washington, D.C. 20590
202/366-4570

Responsible for: setting standards for safety and providing funds to plan, construct and operate transportation systems by rail, highway, air, or water and providing law enforcement and traffic management services for the nation's airspace and waterways. DOT also regulates manufacturers of containers and transporters of hazardous materials.

U.S. coast guard

2100 2nd St., S.W.
Washington, D.C. 20593
202/267-1587

Responsible for: port safety, maritime law enforcement, boating safety, search and rescue, aids to navigation, merchant marine safety, and environmental protection. The Coast Guards works with EPA on marine protection programs, including regulating the transportation of hazardous cargoes, oil pollution cleanup, and marine salvage.

federal emergency management agency (FEMA)

P.O. Box 70274
Washington, D.C. 20024
202/646-4600

Responsible for: providing a federal focus on emergency management in the United States. This includes natural disasters such as earthquakes, hurricanes, tornadoes, and floods, technological calamities, and national security crises.

U.S. geological survey (USGS)

12201 Sunrise Valley Drive
Mail Stop 119
Reston, VA 22092
703/648-4460

Responsible for: analyzing the quantity and quality of surface and ground water and precipitation, and conducting research in geology and hydrology. Programs include extensive topographic and land-use mapping, energy and mineral resource assessments, evaluations of natural disasters, and space exploration.

U.S. department of health & human services:

National Institute for Occupational Safety and Health (NIOSH)

1600 Clifton Road, N.E.,
Building 1, Room 3007
Atlanta, GA 30333
1-800/356-4674

Centers for Disease Control and Prevention (CDC)

1600 Clifton Road, N.E., Building 1
Atlanta, GA 30333
404/639-2888

Agency for Toxic Substances and Disease Registry (ATSDR)

1600 Clifton Road, N.E., Building 1
Atlanta, GA 30333
404/639-2888

NIOSH provides research and evaluation studies of occupational injuries and hazardous substances in the workplace. These criteria are used by **OSHA** for setting workplace safety standards. The **CDC** tracks and evaluates incidence of disease and performs epidemiological studies. **ATSDR** conducts research focused on toxic substances and their effects on public health. Programs include health studies, substance-specific research, and maintaining various disease registries.

U.S. department of labor

Occupational Safety and Health Administration (OSHA)

200 Constitution Ave., N.W.
Washington, D.C. 20210
202/219-8151

Responsible for: issuing standards and rules for safe and healthful working conditions, tools, equipment, facilities, and processes. Employers have the general duty of providing their workers a place of employment free from recognized hazards to safety and health, and must comply with OSHA standards. OSHA conducts workplace inspections to assure standards are followed.

National Oceanic and Atmospheric Administration (NOAA)

14th and Constitution Ave., N.W., Rm 6013
Washington, D.C. 20230
202/482-6090

Responsible for: environmental satellite and data information, oceanic and atmospheric research, sustainable development, coastal management programs, cleanup of oil spills, the National Weather Service, and the National Marine Fisheries Service.

EPA information numbers

In many situations, a phone call to EPA can provide you with the information you need to start working with environmental issues. Below is a list of some of the most useful EPA telephone numbers. Although numbers change periodically, these were correct at the time of printing. All telephone numbers are in the Eastern Standard Time Zone.

general U.S.EPA numbers

Public Information Center
(202) 260-2080
(202) 260-7751

ORD Research Information (Cincinnati)
(513) 569-7562

National Center for Environmental Publications & Information (Cincinnati)
(513) 489-8190

hotlines listed by topic

Acid Rain
(617) 674-7377

Air Control Technology Assistance Center
(919) 541-0800

Air Risk Hotline
(919) 541-0888

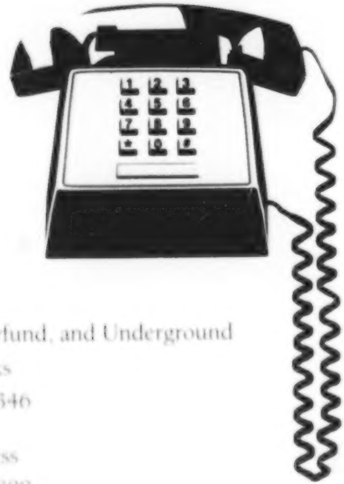
Appropriate Technology (energy: DOE)
(800) 428-2525

Asbestos Ombudsman
(800) 368-5888

Drinking Water
(800) 426-4791

Emergency Planning & Community Right-to-Know
(800) 535-0202

Environmental Education
(202) 260-4962



Environmental Justice	(800) 962-6215
Green Lights/Energy Star Programs	(202) 775-6650
Ground Water	(202) 260-7786
Hazardous Waste Ombudsman	(800) 262-7937
Indoor Air	(800) 438-4318
National Response Center (U.S. Coast Guard)	(800) 424-8802
Pesticides (health effects, spills)	(800) 858-7378
Pollution Prevention Info. Exchange System	(703) 821-4800
Pollution Prevention Clearinghouse	(202) 260-1023
Radon	(800) 767-7236
RCRA, Superfund, and Underground Storage Tanks	(800) 424-9346
Small Business	(800) 368-5888
Solid Waste Information Clearinghouse	(800) 677-9424
Storm Water, NPDES Permitting	(703) 821-4823
Stratospheric Ozone Protection (CFCs)	(800) 296-1996
Toxic Substances & Asbestos Information	(202) 554-1404
Transporting Hazardous Materials (DOT/FEMA)	(800) 752-6367
Waste Water	(800) 624-8301
Wetlands	(800) 832-7828

we want your comments!

Additional copies of this Guide may be obtained from:

U.S. EPA
Public Information Center (3404)
401 M Street, SW
Washington, D.C. 20460
(202) 260-7751

This booklet is intended to help you address environmental issues that interest you. Help us do a better job by letting us know what information you need. Questions or suggestions for future revisions of this Guide can be sent to the Project Manager, mail code (2225), or call (202) 260-9812.

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